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This dramatic photograph was taken from the cofferdam wall, from a point dead astern of the "Maine," when the wreck had been partially unwatered. Captain (now Rear-admiral) Sigsbee and his officers were in this portion of the ship at the time of the explosion. It remains to-day structurally intact.

THE "MAINE," NOW PARTIALLY EXPOSED, ENCRUSTED WITH BARNACLES, AFTER THIRTEEN YEARS UNDER WATER.—[See page 210.]

SCIENTIFIC AMERICAN

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately and in simple terms, the world's progress in scientific knowledge and industrial achievement. It seeks to present this information in a form so readable and readily understood, as to set forth and emphasize the inherent charm and fascination of science.

The Mystery of the "Maine"

PRESIDENT TAFT, in asking for an additional appropriation of $250,000 to complete the work of unwatering and disclosing the wreck of the Maine, undoubtedly voiced the opinion of the nation at large when he said: "As long as there remains unexcavated any portion of the mud and debris within the wreck or in its neighborhood, from which evidences may be had of the original cause of the disaster, we shall be derelict in our duty in not prosecuting a further research."

Interest in the extraordinary operations which are being carried on by our army engineers in Havana harbor in the effort to solve the riddle of the "Maine" is more than national. It is world-wide. Both as an engineering work of unusual difficulty and as a determined attempt to get to the bottom of a mystery which is without parallel in naval history, the work which we illustrate and describe on another page of this issue is of profound interest, and the question will naturally arise at this stage of the proceedings, as to what promise is afforded of determining with certainty whether the "Maine" was destroyed by an explosion from without or within the ship, and whether the disaster was deliberately planned, or resulted from accidental causes.

The work so far done seems to render the problem more perplexing than ever; for the unwatering of the ship has shown that the destruction of that portion of it where the explosion occurred was even more complete than was supposed. The examination made by divers immediately after the disaster showed that for a length of 70 to 80 feet the sides and decks of the "Maine" had been literally blown to pieces. The double bottom, badly broken up and twisted out of shape, was apparently more or less in place, and it was largely upon the testimony of the divers that portions of the double bottom showed that the plating was bent upwards and into the hull, and that a portion of the keel and bottom had been forced up to a point about 24 feet above where it would be had the ship sunk uninjured; that the naval court of inquiry found that "the 'Maine' was destroyed by the explosion of a submarine mine, which caused the partial explosion of two or more of the forward magazines."

In the intervening thirteen years, the wreck of the "Maine" has sunk many feet down into the soft mud of the harbor bottom. Judging from the photograph shown on pages 210 and 211, the keel and double bottom in the region of the explosion must have sunk even further than the wreck itself; else this portion of the wreckage would be visible, where the photograph shows an absolutely clear space. It is stated (though we have no official confirmation of this) that soundings in the region of the gap failed to show the existence of the double bottom. It is conceivable that, becoming detached from the rest of the wreckage, its weight has carried it slowly down to the underlying firmer bottom of the harbor, some sixty feet below the surface of the water. In this case, its recovery and thorough examination will prove to be a matter of extreme difficulty. Failing its recovery, the question as to how the "Maine" was destroyed must forever lack a definite and convincing answer.

The mystery of the "Maine" is to-day as profound as ever. Every hypothesis that has been offered presents insuperable difficulties. The suggestion that the deed was done by the Spanish government through its naval or military officers has, from the very first, been scouted by the naval and military men of the United States, who point to the fact that the Spaniards are a proud and a high-minded people, whose naval and military men are above all suspicion of so foul an act as the sinking of the ship of a friendly nation. Furthermore, the events of the war showed the Spaniards were woefully inefficient in the handling of mines and torpedoes; as witness the case of the battleship "Texas," which fouled a floating, Spanish contact mine with one of her propellers without causing it to detonate; furthermore, her mining and torpedo operations in general proved to be equally futile.

The suggestion that the "Maine" was sunk by Cuban conspirators in the hope of embroiling the United States and Spain is disproved by the fact that it would be impossible to lay a large mine in the area over which the Maine would swing at her mooring and connect it with two independent observation stations on shore, without attracting public attention. The mine would have to be carried out on a lighter or vessel of considerable size, moored in place, and electric cables paid out from the mine to an observing station, which would itself have to be connected by telephone with another observing station, each station being equipped with instruments to determine the exact moment at which the "Maine" was floating above the mine. The attempt to anchor a floating contact mine would present almost equal probabilities of detection.

Lastly, it has been suggested that the entrance to the harbor may have been mined, and that one of the mines may have broken loose or dragged its mooring, and come in contact with the ship, which was located, we believe, not very far from the harbor entrance. The trouble with this theory is that contact mines would scarcely be placed in a waterway where ships were free to come and go; and that, if the mine had broken adrift and was floating at the surface, the incurved plating which the divers discovered would have been the side plating at the water line, and not that of the double bottom.

There remains then the theory that the "Maine" may have been destroyed by an internal explosion, presumably of the magazines; but this suggestion is strongly controverted by the testimony of Capt. Sigsbee before the board of inquiry, which showed that on the fatal night everything connected with the ship was perfectly normal. The guncotton was stowed aft under the cabin, as were the torpedo warheads. The gun cotton primers and detonators were aft in the captain's cabin, and no torpedo was fitted with a warhead at the time of the explosion. As to the magazines, they were on that night at the normal temperatures for a tropical climate. There was no loose powder in the magazines. The magazines had been subjected to the regular inspection, the doors locked, and the keys were in the captain's cabin (from which they were recovered after the ship sank) at the time of the explosion. The evidence on this point is strongly against the possibility of any malicious blowing up of the magazines.

There remains the theory of spontaneous combustion of the magazine powder. This is rendered unlikely by the fact that the gunpowder for the big guns was entirely of the brown prismatic type; which, as is well known, is one of the safest powders known, and is not subject to any chemical deterioration, such as occurs in the smokeless nitro-glycerin powders. Had the magazines that exploded contained big-gun charges of smokeless powder, it is conceivable that spontaneous combustion such as, a few years ago, destroyed the French battleship "Jena," might have wrecked the "Maine."

On the other hand, the evidence shows that there was a small arm ammunition locker forward, and that it contained a new supply of ammunition for small-arm and small rapid-fire guns. This was presumably of the smokeless variety, and this fact will naturally raise the question as to whether the mischief might have originated at this point.

A Record Aeroplane Tour

WHEN he alighted upon Governors Island at 2.38 o'clock in the afternoon of Friday, August 25th, Harry N. Atwood completed his long journey from Chicago in triumph and established a new record for long distance travelling by aeroplane. He started from St. Louis at 8.05 A.M., August 14th—12 days before—and, flying from 40 to 150 miles each day, he completed the 1,265-mile trip without difficulty or serious mishap. His journey is the longest ever made across country by aeroplane, and the first real pleasure tour. Atwood was able to fly every day, and each day he made headway, although on a few he was obliged to wait until late in the afternoon for the wind to die down. His longest day's flight was 286 miles made the first day and his shortest 27 miles made the last.

When he passed Rhinecliff, N. Y., at 8.39 A. M., the day before he finished, Atwood was 13 miles ahead of the long-distance record of 1,164 miles made in 30 days in a circuit race in Germany. The European circuit aeroplane race was only about 1,000 miles in length and it required nearly a week longer than the time required by Atwood. The circuit of Britain race, 1,060 miles in length, although completed by Lieut. Conneau and M. Vedrines, in three days, was only finished by Mr. Valentine, on a French monoplane, and Capt. Cody, in his huge British-built biplane, in 13 and 14 days respectively. Thus it can be seen that Atwood surpassed their performances despite the engine trouble which delayed him considerably during the last three days of his trip. At one time, while he was nearing Albany, he was obliged to alight and tighten the bolts which secured the engine to the frame of the aeroplane. In ten minutes he was *en route* again. After circling about the capital city of New York State he was compelled to descend at Castleton, a few miles further down the river, on account of the burning out of a bearing in the motor. After rebabbitting this bearing over night, he made a fine flight down the river, dipping suddenly and passing under the Poughkeepsie Bridge, and circling over the parade ground at West Point, but he did not land on the parade ground owing to his fear that he could not start from the field successfully because of the trees and buildings surrounding it. Instead he alighted high up on the other side of the river, at Garrisons, replenished his fuel, and started for New York. When at Nyack, a half hour later, the motor suddenly gave out and he was obliged to find a landing place quickly, as he was not at a very great elevation. Dexterously guiding his machine, he alighted on a narrow patch of open field between a barn and an apple orchard. The motor was repaired overnight, and the next day, despite the thorough soaking which the aeroplane received in a heavy rain the night before, Atwood was able to make the trip successfully under lowering skies and with a strong wind at his back. Under these weather conditions he was only 43 minutes in covering the 27 miles to Governor's Island.

The total flying time of the Burgess-Wright biplane used by Atwood was 28 hours and 31 minutes, which corresponds to an average speed of 44.38 miles an hour throughout the long trip. The journey was accomplished in twenty flights of an average length of 63¼ miles. Every time the machine alighted and started again without mishap, and the fact that it was never damaged, even in the dangerous forced descent at Nyack, speaks well indeed for Atwood's skill as an aviator. His flight shows up well in comparison with the *London Daily Mail's* Circuit of Britain race and endurance test as, like the competitors in this English event, he did not change his engine or any essential part of the machine. Furthermore, he had several days of more difficult flying around the Great Lakes and above the Hudson, than was experienced by any of the aviators mentioned above in the British contest. While flying over the water was dangerous for Atwood, even with pontoons on his biplane, with a hydro-aeroplane such as Curtiss has devised, it would be preferable to follow rivers and canals, upon which a forced descent could always be made without danger.

The successful termination at New York of Atwood's tour has shown America to still be in the lead as regards the practical use of the aeroplane for pleasure and touring purposes. While France has made a far greater use of it for military purposes, and England is taking it up for carrying of the mails, a young American with only a few months' experience in flying, has shown that it is possible to tour for pleasure and without danger in an American aeroplane, fitted with an American motor. The lesson taught by the motor troubles which he experienced is that for safety a touring aeroplane should be equipped with two separate engines, so that in case of failure of one, the other can be used. Mr. Edwin Gould foresaw this necessity two years ago and offered a generous prize of $15,000 through the SCIENTIFIC AMERICAN for a twin-motor aeroplane. Already one American monoplane has been built and flown with two motors, and several machines of this type, we understand, have also flown abroad. The Gould prize is still open for competition, and we hope that by July 4th of next year, at least half a score of aeroplanes will be built to compete for it.

Hospital Cars of the Swiss Federal Railways

Carrying the Sick by Rail

By Dr. Alfred Gradenwitz

THE Swiss Federal Railways have recently added to their rolling stock several hospital cars, which are intended for the conveyance of sick and invalid travelers, and whose equipment represents the most modern development in this direction. The cars are placed at the service of private parties, and being intended especially for long journeys, they are fitted out with all the technical equipment to adapt them for travel over the various European railway systems.

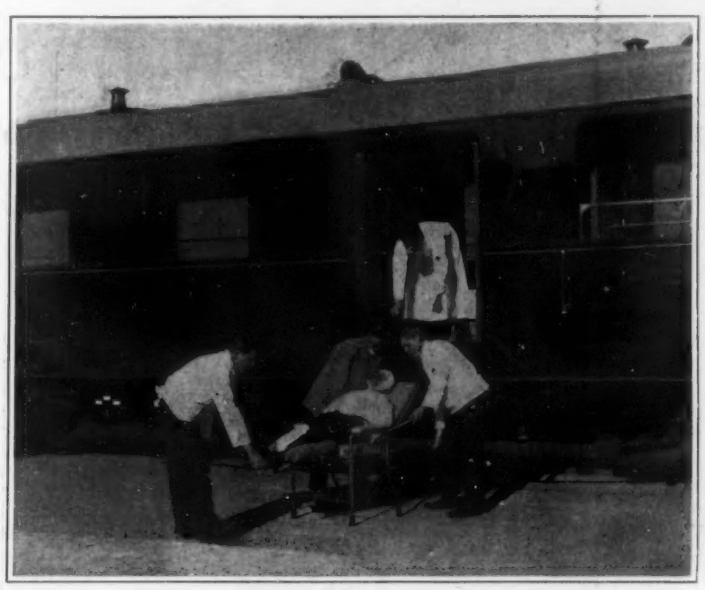
The hospital car is built as a four-axle corridor carriage with two bogies, its length between buffers being 63½ feet and its total weight in working order 41½ tons. Not only is it fitted to travel on all standard-gage railway lines of the Continent, but it is designed also for transfer on the Scandinavian and Sicilian ferry-boats.

In addition to the brakes ordinarily in use on Swiss railway lines—namely, an automatical Westinghouse emergency brake with a braking cylinder of 8,800 pounds normal piston pressure, combined with a Westinghouse regulating brake there is provided a Hardy switching vacuum emergency brake with two cylinders of 3,080 pounds lighting power each, which are designed for automatic working as well as for direct manipulation. As French railways still use emergency chains for safety couplings—the hose couplings of the two Westinghouse brakes being located between the chains—three pairs of Westinghouse braking hose had to be arranged at each end of the wagon. The brake can also be controlled by means of a hand-wheel from each platform. In each compartment in the car and also in the passage, there is a safety brake, with one handle for actuating both the automatic Westinghouse brake with the signaling whistle and the electrical interconnection signal of the Paris-Orleans Railway or the automatical Hardy brake. In addition each wagon is fitted with the Prudhomme electrical inter-connection signal of the French and Belgian Northern Railways, the alarm bell line of German D-trains and the holders for the alarm cord prescribed by Austrian railways. Ten signal holders of different designs had to be put in so as to comply with the special regulations of each of the railways on which the car is intended to travel.

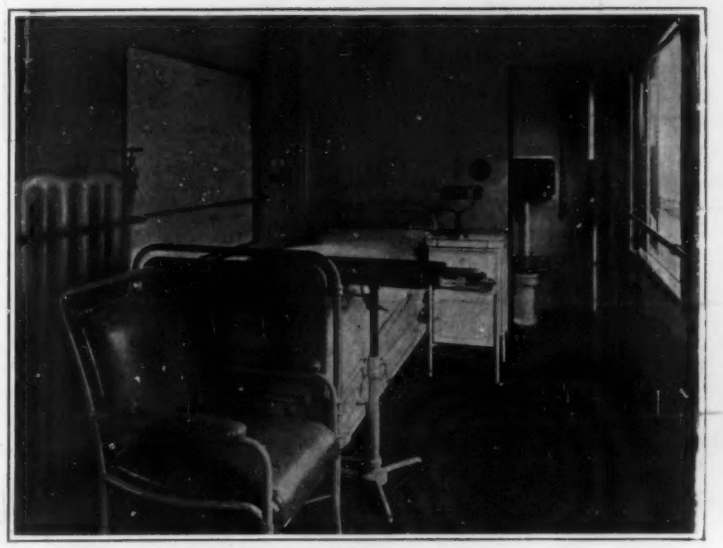
The car is heated by steam circulating in smooth tube radiators with Wilhelm regulators in general use on the Swiss Federal Railways. In order to insure a satisfactory gradation of heat, a radiator with Jenkins's regulating valve is provided in the sick-room. A hot air heating installation on the Pape-May system serves to heat up the car when stalled or before starting or when traveling lines not equipped with steam heating. All the various compartments of the car are electrically lighted on the Brown, Boveri & Co. system the total candle-power being 272. The dynamo driven through belt transmission from one of the car axles in conjunction with eight accumulator batteries of 1,600 watt-hours each, also supplies electrical energy for various apparatus with which the car is equipped.

The sick-room, which is located in the middle of the carriage, and the adjoining lavatory, are fitted up aseptically in the same manner as up-to-date hospital rooms, all the walls, ceilings and floors, as well as the furniture, being readily washed and disinfected, while all the angles of the walls and ceiling are rounded off and any joints covered over with smooth nickel-plated metal rods. The walls and ceilings are painted with white enamel and simple decorative patterns. Extensive use has been made of glass, porcelain, marble and nickel-plated metal. The floors are lined with inlaid linoleum.

The sick-room contains a good bed with iron frame and steel mattress and a removable nickel-plated lifting device. The horse-hair mattresses are made in three parts to facilitate disinfection; a chest of drawers fitted into the wall contains several changes of bed linen. The sick-room further contains a bed-table with adjustable plate, and iron cabinet with marble plate and enameled case, an upholstered easy chair with iron frame and washable leather lining, and a divan also coated with washable leather, the hinging back of which can be used as emergency bed, after covering it with horse-hair mattresses. In addition to a drop-light, there is provided a portable electrical wall and table lamp whose light can be cut off by means of an inclosing shade. An electrical heating pan serves to heat the bed. There is, of course, the usual electric bell call for the nurse, and a wall fan for ventilation. The sick-room is accessible from outside through broad folding doors in the side-walls, through which the invalid can be brought in on a stretcher or Sedan chair.



Taking the patient on board.



The sick-room of the hospital car.

CARRYING THE SICK BY RAIL

Adjoining the sick-room are the quarters for the attending physician or nurse. The furnishings here include sleeping accommodation and an upholstered seat coated with washable leather; further a folding table and a metal and plate glass cabinet for medicines surgical instruments dressing, etc.

A first-class compartment for the patient's relatives or friends is attached, this also being equipped as a "sleeper."

The seats are lined with bright gray cloth to match the carpet. All metal parts throughout the carriage are nickel-plated.

The kitchen is equipped with an ice-box for food and drink and to store ice for medical use; there is a marble topped table and a fire-clay sink on nickel brackets with self-locking water faucet. Under the kitchen table there is a small chest of drawers for polishing utensils and on top of the ice box a crockery cabinet in which the kitchen linen is also kept. The kitchen is operated electrically, its arrangements comprising two quick-acting radiators with Cardan suspension and a roasting pan. Both the wall and ceiling are lined with sheet-iron and painted with bright enamel. Over the kitchen as well as the lavatory are arranged water tanks of tinned copper plate, containing a total of about 1,000 liters of water, thus providing an ample water supply. These water tanks can be fed directly from the roof or from underneath through a pressure conduit. The baggage compartment can be heated and contains a folding bench for domestics. A special lavatory is provided for general use. The passage also contains an upholstered hinging seat for domestics.

All the sliding doors of the carriage run on ball-bearings.

Four carriages of this type, constructed by the Schweizerische Industrie-Gesellschaft of Neuhausen, have so far been placed on the tracks.

The Completion of Hann's "Climatology"

HOFRATH Prof. Dr. Julius von Hann, the venerable and venerated Austrian meteorologist, has just published the third and final volume of a revised and greatly enlarged edition of his "Handbuch der Klimatolcgie." The first edition appeared in 1883, the second in 1897, and the first volume of the third edition, just completed, in 1908.

Although dealing with a subject of universal interest, viz., the climates of all parts of the world, this work has for many years enjoyed the position of being *sui generis*. Since the appearance of Voeikov's "Klimate der Erde," in 1887, no other work discussing this subject in detail has appeared, in any language. The climatolcgists of the world appear to have recognized that Hann was better able than any one else to handle the subject adequately, and have left him the undisputed master of the field. His manner is encyclopædic. Reading omnivorously, and writing with unflagging industry in spite of advancing years, he has produced a digest of nearly all the existing literature of climatology and climatography; a fitting companion-piece of his "Lehrbuch der Meteorologie" published in 1901, and in a more condensed form in 1906. The "Klimatolcgie," like the "Meteorolcgie," is, however, more than a digest; it is also an indispensable bibliography, as it contains thousands of references to the literature on which it is based. Moreover, these references are not confined to scientific literature; popular books of travel, for example, have been laid under heavy contribution.

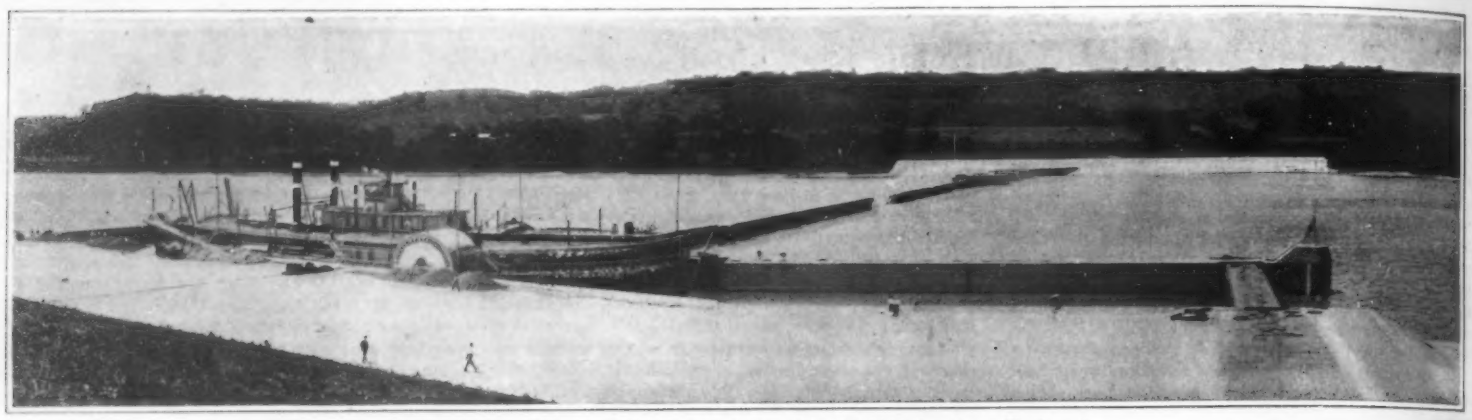
An English version of Hann's unique work is sorely needed. In 1903 Prof. Ward, of Harvard, published an admirable translation of the first volume of the second edition; but this deals only with climatology in general, not with the climates of particular countries.

Niagara and Victoria

WHAT is the true comparison between the power of Niagara and the Victoria Falls in South Africa?

The answer is that the flow at Niagara varies between 62,000,000 and 104,000,000 gallons per minute; that at Victoria is as low as about 5,000,000 gallons in August.

The mean available drop at Niagara is 160 feet and at Victoria 380 feet. Hence, while the minimum Niagara flow represents about 3,000,000 horse-power, the Victoria flow in August represents only 580,000 horse-power, and, accepting the statements of local authorities that in November the flow at Victoria drops to only 2,500,000 gallons per minute, the minimum horse-power there can be only about one-tenth of Niagara's minimum. The maximum of Victoria is not given.



Bird's eye view of the Fernbank dam just opened in the Ohio river near Cincinnati.

The Largest Movable Wicket Dam

Providing a Nine-foot Boating Stage of Water in the Ohio River

THE largest movable wicket dam in the world and the only one built entirely of concrete and steel has just been opened for business in the Ohio River near Cincinnati.

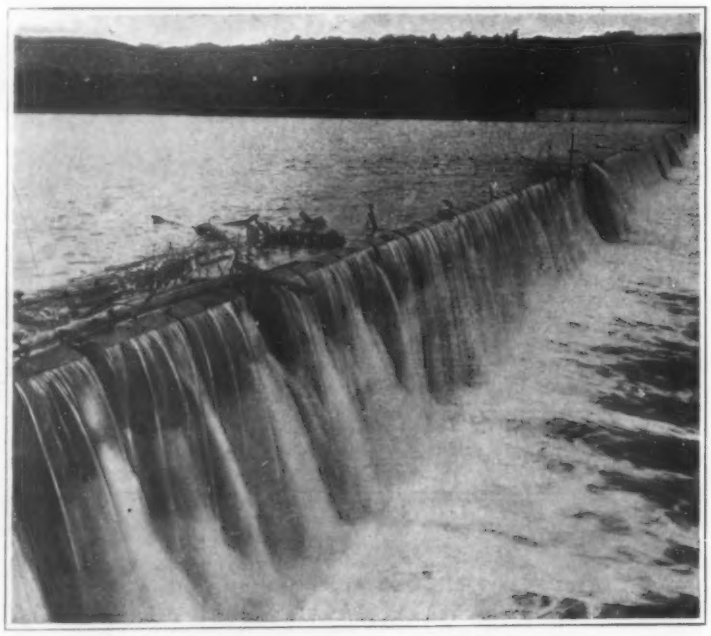
When the steamboat "Indiana" passed through the lock on July 25th, as here shown, the event marked the completion of a six years' task in building one of the most remarkable dams, indeed, the only structure of its kind. No other dam is built entirely from concrete and steel.

There are 60,000 cubic feet of concrete in the structure, of which 35,000 feet is under water and cannot be seen at any time. All the gravel, sand and crushed stone used in this vast amount of concrete was excavated on the site of the big dam when dredges scooped out the river's sandy bottom down to bed rock where all concrete footings are planted.

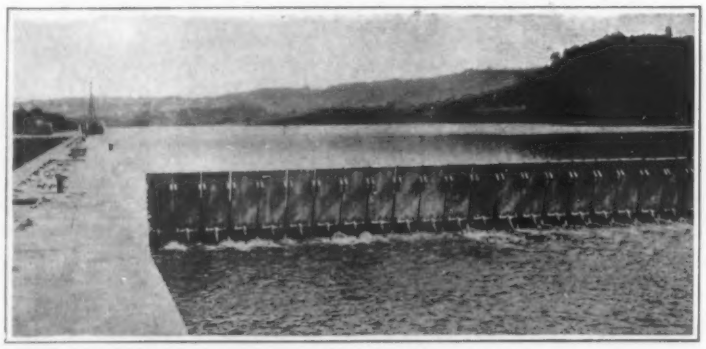
The foundation for the dam proper extending across the river is of concrete and steel and arranged so that the movable wickets work independently of each other and may be removed like so many pegs from so many holes. The one illustration shows the government dredge boat beginning to stand the wickets in place in their sockets on the bed of the river. The long line of wickets forms the dam to hold back the water. The mechanism of the dam allows these movable wickets to be dropped flat upon the bottom of the river bed or raised at will by means of compressed air. These movements are controlled from the Ohio shore.

The working of the dam proper regulates the height of water in the 25-mile pool above it. When the river is high and there is no need of the artificial stage of water the wickets are lowered flat on the bed of the river and craft pass over as if no dam were there; but when the water is low and the stage of water is artificially formed above the dam the craft must pass through the lock on the Ohio shore from the higher or lower stage, or from the lower to the higher, according to the direction in which the boats are traveling, as illustrated in the photograph showing the steamer "Indiana" passing up stream through the lock canal along the Ohio shore. The government has appointed four lock keepers to transfer these boats through the big dam. These men work in shifts.

That the big Fernbank dam, known officially as No. 37, is a big success may be gleaned from the fact that the United States government will build others like it in the Ohio River to make that stream navigable the year round from Pittsburg to Cairo, a distance of more than a thousand miles. It is a step completed to establish a permanent stage of not less than nine feet of water in the Ohio River the year round. This dam located at Fernbank, Ohio, twelve miles below Cincinnati, will give Cincinnati a permanent minimum stage of nine feet of water for a distance of 25 miles. It cost the government $1,500,000. Early in September people of the Ohio Valley will gather in Cincinnati and the structure will be officially dedicated.



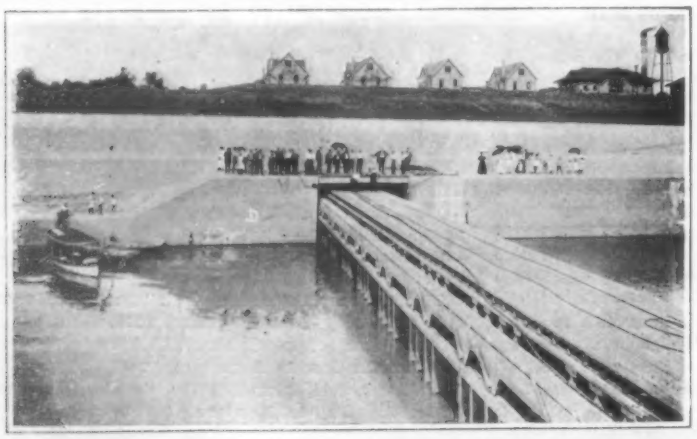
How the water pours through the Fernbank dam.



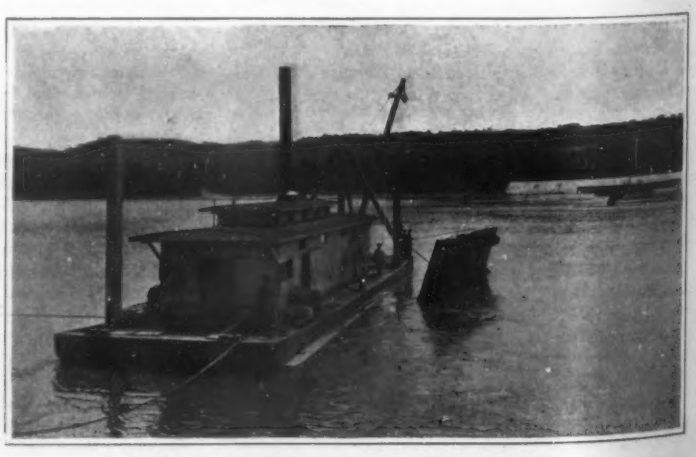
The dam is composed of a series of hinged wickets.

The Pebble Industry

A PECULIAR form of mineral wealth is found on Plum Island and Goose Island, two of a row of islands lying between the northern point of Long Island and Watch Hill. It consists in heaps of richly-colored quartz pebbles, showing red, yellow, purple, and other hues, which are locally called agates. They are used in making stained-glass windows, and there is a sufficient demand for them in New York to keep the owners of one or two sloops employed in gathering them from the beaches, where the waves continually roll and polish them, bringing out the beauty of their colors.



The gate is mounted on wheels like a freight car on a track like that of a railroad.



Government dredge setting the wickets in place.

THE LARGEST MOVABLE WICKET DAM

The Isolation of an Ion

Measuring the Smallest Thing in the World

By William J. Humphreys, U. S. Weather Bureau

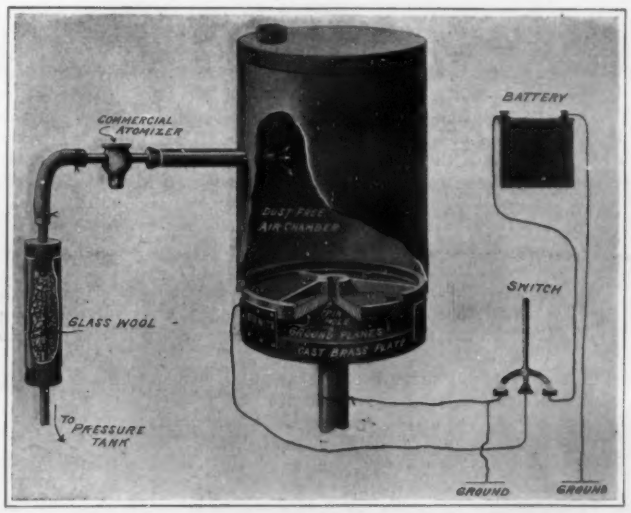
JUST as the accurate measurements of controlled phenomena have taught us much that is definite and much that is useful about the divisibility of matter, so also cleverly designed and skillfully executed experiments are giving us equally definite knowledge of the atomic nature of electricity, of the fact that there is a measurable and seemingly ultimate limit to the divisibility of an electric charge, and what the exact magnitude of the ultimate charge is.

Like nearly every other discovery of importance, this one, too, has a long and an honorable history. In fact it can be traced back, step by step, almost a century.

The first, and in many ways most fruitful contribution to this subject, was made by that prince of experimenters, Michael Faraday. It consisted in proving that when an electric current is passed through a water solution of any one of certain substances, the substance itself is taken out of the solution, to an extent dependent entirely upon the quantity of electricity so passed, and upon the nature of the substance dissolved. Thus, when the same current is passed in series through the water solutions of several salts, such as sodium chloride, silver nitrate, copper sulphate, and the like, the weight of the metal deposited, or, under proper conditions, permanently removed from the solution, is directly proportional to the atomic weight of the metal itself, and inversely proportional to its valency, that is to say, to the number of hydrogen atoms necessary chemically to take the place of one atom of the metal. This proportionality between the quantity of electricity passed through the solution, and the resulting amount of chemical decomposition, holds rigidly true, within the limits of experimental error, under all conditions, and hence it seems practically certain that to each ion in a solution conveying an electric current there belongs a definite electrical charge; and that the smallest of such charges is that carried by a single hydrogen atom, or by a single atom of any other univalent substance. A bivalent atom, such as copper in copper sulphate, carries just twice the smallest, or univalent charge; a trivalent atom three times the smallest charge; and so on for atoms of still higher valency. Hence, in electrolytic solutions there is a measurable "smallest possible charge," of which larger electrolytic charges are only definite multiples.

A natural inference from these experimental facts would be (and this inference was drawn by many) that electrical charges are just as definitely atomic in their nature as, for instance, is a mass of iron. That just as, under given conditions, there is a limit to the actual, though not to the conceivable divisibility of matter, so too there is a limit to the actual, though again not to the conceivable divisibility of an electric charge. This, however, was only an inference, and for many years the way to test it, in the case of any quantity of electricity other than that used in the decomposition of an electrolyte, was not evident. Besides, even in the process of electrolysis, the most refined measurements could directly detect nothing less than the aggregate of countless millions of elementary charges, so that the value of the unit charge was only inferentially and not immediately determinable.

Prof. R. A. Millikan, who has isolated an ion and measured the ultimate unit of electric charge.



The apparatus by means of which Prof. Millikan has isolated an ion and measured its charge.

About a dozen years ago, J. J. Thomson, H. A. Wilson, and C. T. R. Wilson began, in the Cavendish laboratory at Cambridge, England, a series of most ingeniously devised and skilfully executed experiments that proved the existence of minute electrical charges in conducting gases, and showed their average value to be, as nearly as could be determined, the same as that of the electrolytic charge spoken of above.

C. T. R. Wilson showed that a fog of water particles will form in dust-free air whenever the degree of super-saturation is sufficiently pronounced. If the air is ionized, or has been rendered conducting through the action of X-rays, or otherwise, then a four-fold super-saturation causes condensation of the water vapor on the negative electrons; a six-fold super-saturation gives condensation on the positive electrons; and an eight-fold on the neutral molecules of the gas itself.

Now, a knowledge of the amount of water vapor present, and of the extent of the cooling below the dew point by which the super-saturation is produced enables one easily to compute the weight of the water condensed as fog. Furthermore, if the fog is left to itself, it slowly settles at a rate which, as Stokes proved long ago, depends upon the size of the individual particles and upon the viscosity of the medium through which they fall.

A measurement, then, of the rate at which the fog falls, since it all falls at about the same rate, enables one to calculate the size of the individual particle, and this knowledge of the size of the particle, together with a knowledge of the amount of water condensed, at once gives the total number of particles.

On bringing a charged body near this electrified fog its motion is modified, and a means is at hand for measuring the magnitude of the charge on each particle. Probably the simplest method of measuring this charge, through the behavior of the fog as a whole, is that devised by H. A. Wilson. The rate of fall of the fog is measured when there is no external electric field acting on it, and thus the size and weight of the individual particle determined. After this, a vertically directed uniform electric field is brought to bear on the particles, and regulated to just counteract the force of gravity, so that the fog neither rises nor falls. Under these conditions of equilibrium the value of the charge on each particle of fog, multiplied by the strength of the field, is equal to the weight of the suspended particle, and hence when both the weight of the droplet and the strength of the field that keeps it in suspension are known, the numerical value of the charge is also known.

All this, however, assumes that the rate of fall of the fog *en masse*, the group rate, is the same as would be that of a single one of its droplets if alone. This, as a matter of fact, is not rigidly true.

For this, and for other reasons too, it seemed extremely desirable to Prof. R. A. Millikan, of the Ryerson physical laboratory, at the University of Chicago, somehow to isolate and to measure an ion entirely by itself.

A few years ago it would have been almost silly even to have dreamed of accomplishing such an experimental feat. But Prof. Millikan has most cleverly solved this seemingly impossible problem, and by so doing probably has made by far the most accurate of all determinations of the value of this fundamental unit, the atom of electricity. Nor is this all, for the improved value of this unit carries with it correspondingly corrected values of other things—such as the number of atoms per unit weight of any given element, and the mass of the individual atom itself.

The full account of this ingenious and valuable investigation is given in the *Physical Review* for April of this year, and should be consulted by any one especially interested in the subject. In brief the process by which single ions were isolated and individually measured was as follows:

A fine spray of oil was blown by dust-free air into a dust-free chamber, the bottom of which was closed by a brass disk 22 centimeters in diameter. The center of this disk, which was perfectly plane on the under side, was pierced by a pin-hole, through which an occasional oil droplet fell. Strictly parallel to this disk, and just 16 millimeters below it, was another brass disk of the same size. A band of thin ebonite was bound around the edges of the disks, while ebonite rods kept them fixed in position and also strictly insulated from each other. In this way a cylindrical air chamber, 22 centimeters in diameter and 16 millimeters long, was formed between the two parallel brass plates.

A parallel beam of light was passed through two diametrically opposite glass covered holes in the ebonite band, and hence immediately beneath the pin-hole in the upper plate. Through a third glass covered hole in the ebonite band a low power telescope was so focused as to show distinctly any object floating in the air immediately beneath the pin-hole. As soon as one or two droplets chanced to fall through this opening, and, therefore, into the field of the telescope, it was closed by an electromagnetically operated cover, so as to prevent, as far as possible, all disturbances due to air currents. Changes in the size of the drop were almost entirely eliminated by the use of substances that evaporate slowly, and by the additional precaution of having the volume of the cylinder, through moistening its walls, already saturated with the vapor of the substance used.

The rate of fall of the droplet, due to the force of gravity alone, was measured, and in this way its size and mass approximately determined, as above explained. The plates were then charged to a known difference of electrical potential and hence the move-

ment of the droplet, if electrified, was changed. The new velocity was measured and its direction noted. These measurements with the electric field alternately off and on were repeatedly taken, but during the course of the observations it frequently happened that the droplet encountered and entrapped a free ion of one or the other sign, as was evidenced through its abrupt changes in velocity. The more ionized the gas, the more frequent the captures.

By this process free gaseous ions of either sign have been captured at will, either singly or in multiples, and their magnitude has been so carefully measured, under conditions so free from assumptions, that the size of the electrical atom, the smallest quantity of electricity now attainable, is known probably to within one part in 500 of its actual value.

Numerically this value is the absolute electrostatic unit multiplied by 4.891×10^{-10}, a quantity incomprehensively small. To illustrate its excessive minuteness, let us suppose one hundred millions of people should begin to collect and count these atoms of electricity, just as Prof. Millikan has collected and counted them, only at the extraordinary rate of 100 every minute, and let them keep steadily at 't until they had enough to generate by electrolysis sufficient hydrogen to fill a child's toy balloon of some eight inches diameter. Certainly this would not be enough electricty to consider in any commercial transaction, and yet it would take the above hundred million hustlers geological ages—in fact something like four millions of years—to collect it by the process described. Surely, then, the electric ion is small beyond comprehension, and its definite isolation and exact measurement stands forth as one of the cleverest, as it is also one of the most important, achievements of modern physics.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Right and the Wrong Way of Mining Coal

To the Editor of the SCIENTIFIC AMERICAN:

Dr. Holmes's article upon the conservation of the coal resources was highly interesting, and from the viewpoint of the scientist leaves nothing to be desired. It was, to my mind, the distinctive feature of your issue of August 12th, 1911. With your permission I would like to state a mere layman's side of coal conservation.

To clearly convey my meaning I will use two mines about 900 miles apart. The Blossburg, Pa., coal region has five veins of coal; that of the Sullivan County, Indiana, region has seven veins of coal. Now note the difference between mining systems.

The lower drift at Arnot, Pa., has been worked since 1866. There was seldom less than 800 miners employed in it. The workings extend over 23,000 acres and 96 per cent of the coal is taken from the workings. In the forty-five years the mine has been worked but six men have lost their lives while digging coal, and an accident is a very rare occurrence. That I term the correct method of working a coal mine.

In Sullivan, Indiana, a coal mine has been worked seventeen years. About 150 miners are employed. The workings extend over 600 acres. An average of seven men have been killed in it each year, while accidents are of almost daily occurrence. That I call the incorrect method, for less than 60 per cent of the coal is taken out.

The method of working at Arnot, Pa., is this: All coal is both undercut and sheared by pick or machine; then a few ounces of powder brings down the coal without shattering the strata above, so that when the out-crop is reached the pillars can be drawn, thus leaving but three or four per cent of the coal behind.

The freedom from death and accident is due to this: When the miner reaches his room he immediately takes his lamp from his head and cautiously raises it once in a while to see if the flame will denote the presence of fire-damp. If so, he does not blow it out, but slowly puts it down on the ground and extinguishes the lamp by placing his coat over it. When the miner reaches the "face" he takes a pick and sounds the roof to find out if there is any loose rock overhead. If so, he either wedges it down or sets a prop under it. Though the mine is full of coal dust no dust explosion ever took place in it.

At Sullivan, Indiana, the coal is "shot from the solid." Little or no under-mining is done. Each miner uses at from five to ten pounds of dynamite or an equally strong explosive each day. This not only loosens the coal, but shatters the roof also, so that if a vein of coal is above the one worked it is extra hazardous. It does more. It causes the almost daily accident and the loss of about 40 per cent of the coal in the mine. It is rarely possible there to draw the pillars. So the net result is the loss of 40 per cent of the mine worked, the almost entire loss of the vein above and a continuous maiming and killing of the miners.

Consider this matter in another way: Supposing a half ton or more of dynamite were exploded in five and ten-pound charges in the streets of a city within one hour. What would be its effects in the open? Apply this, then, to what must be the effect of the explosion of a similar amount in a mine where the effect of the explosion has but a single direction to expand. All this is to take place within the area of fifty acres.

The method used in Indiana is in vogue all over the West. It is wasting, criminally wasting, a large percentage of the most valuable of nature's gifts and causing a wholesale slaughter of men. I edited the national official organ of the coal miners for seven years, and my observtions, extending practically all over the coal fields, taught me that there was but one way to prevent the slaughter of miners and the criminal waste of coal, to wit: To make it a penal offense to shoot coal from the solid or to attempt to get it without undercutting and shearing the "shot" with either pick or machine.

What would be the result? But one-tenth of the powder would do the work; there would be no dust explosions, for little dust would be made; the strata above would be practically unharmed, thus preventing the killing and maiming of miners and securing over 90 per cent of the coal.

That this is so is again illustrated by coal regions separated only by county lines, Allegany County, Maryland, where the method used is similar to that used in Arnot, Pa., with similar results, and Allegheny County, Pa., where the Indiana method is used and the same results ensuing.

When I stated these things in the miners' organ the operator would sneer at them because he wanted to get the greatest amount in the shortest time regardless of the wrong he was doing to the country and the injury to future generations. Many miners indulged in somewhat heated criticisms of myself, for they, too, wanted to get the most for the least.

Some day, some time, we will secure a legislator and a Congress with patriotism and courage enough to enact laws that will stop this devastation and the destruction of an asset incalcuable in value.

Blossburg, Tioga County, Pa. S. M. SEXTON.

Eugenics and the Conservation of Humanity

To the Editor of the SCIENTIFIC AMERICAN:

Conservation of American forests is important. So is conservation of American coal, and oil, and natural gas, and water supply, and fisheries. But the conservation and improvement of the American race is far more important than all other conservation. The real wealth of a nation is the quality of its people. Of what value are endless acres of forests, millions of tons of coal, and billions of gallons of water, if the race is not virile, and sane and sound? You have shown a fine discrimination in including an excellent editorial on eugenics in your Conservation Number, and as one of your many readers I wish to thank you heartily for it. Germany is ahead of us in her forest policy. She is also ahead of us in her efforts to improve and conserve her people. England is ahead of us, too, in the practical interest which is now taken there in the splendid work of the National Eugenics Laboratory of the University of London, and of the Eugenics Education Society. In the United States we are just beginning to take notice of the work of foreign investigators along eugenic lines, and slowly but surely the painstaking researches of Dr. Charles B. Davenport, and of his colleagues of the Committee on Eugenics of the American Breeders' Association, are attracting attention and will lead to action.

Fearfully misguided has been most of our so-called philanthropy. We have housed and clothed and fed the defective, the degenerate, the delinquent, to such an extent that we have encouraged them to reproduce their kind in ever-growing numbers. We have spent increasing sums for asylums, almshouses, prisons and hospitals, in which we have *temporarily* confined the insane, the pauper, the habitual criminal, the imbecile, leaving them free, during most of their lives, to propagate their kind. It is a fact, disguise it as we will, that we have taxed ourselves to support institutions which have resulted in increasing, and not decreasing, the number of the unfit. We have before us an immediate duty, of tremendous importance, in caring for our own unfit; in seeing to it, by adequate legislation, that the insane, the habitual criminal, the feebleminded and similar classes are *permanently* segregated, so that they cannot reproduce their kind to be a further burden upon the nation, and in enacting laws which shall prevent the marriage of those whose offspring will be unfit.

But, in addition to our own very heavy burden of those who are defective or degenerate, we are adding every year, by immigration, many hundreds if not thousands of aliens whose presence here will inevitably result, because of their own defects, or those of their offspring, in lowering the physical and mental and moral standards of the American race. We, in the United States, have a wonderful opportunity to apply eugenic principles, upon a scale which no other nation can begin to approach, in our power to select and regulate alien immigration. Unprejudiced experts are agreed that our present very liberal immigration laws do not suffice to preserve the *status quo*—physical and mental—of our population, and are very far indeed from promoting any improvement. We are here forming a new race, extraordinarily heterogeneous in character, yet we are to-day taking more care to see that a Hereford bull or a Southdown ewe, imported for breeding purposes, are sound and free from disease than we take in seeing that the alien fathers and mothers of future American children are sound and strong and sane and fit. Biologists admit that they have much to learn about heredity. But of some things they are already sure. Enough is known to make it absolutely essential, if the quality of the American race is to be preserved, that there should be a far more careful selection of our incoming alien immigrants, on eugenic grounds, than we have ever attempted.

The need is imperative for applying eugenic principles in much of our legislation. But the greatest, the most logical, the most effective step that we can take is to begin with a proper eugenic selection of the incoming alien millions. If we, in our generation, take these steps we shall earn the gratitude of millions of those who will come after us, for we shall have begun the real conservation of the American race.

Silver Lake, N. H. ROBERT DEC. WARD.

Education and Success

To the Editor of the SCIENTIFIC AMERICAN:

Your article on the above subject in the issue of June 3rd appeared to me most admirable, and the conclusion that "your success is measured not by what the world gives to you, but by what you give to the world," one to be written in letters of gold.

But is not the chief object of each one of us personal happiness? And how is the question affected when we consider personal happiness? Who are the happiest of human beings? After a long life, in which I have met and consorted with all sorts and conditions of men, I cannot help thinking that what Greville recorded—I write from memory—nearly one hundred years ago is true: The men who pass their lives absorbed in personal ambition, personal aggrandizement, or personal pleasure, are *not* happy. Those who live for others or seek their highest personal manifestation in labors to advance art, science, literature, and morality *are* happy.

If, then, the greatest success man can attain on earth is personal happiness, we again find that "*your success is measured not by what the world gives you, but by what you give the world.*"

F. C. CONSTABLE, M.A.

Wick Court, near Bristol, England.

Preservation of Niagara Falls

To the Editor of the SCIENTIFIC AMERICAN:

I take this occasion to compliment you upon your strong editorial stand for the preservation of Niagara Falls. Though everyone knows that the SCIENTIFIC AMERICAN is published for the scientific and the industrial arts, it is certainly refreshing to see a journal of your class have some feeling and regard for America's natural wonders.

These wonders, and particularly Niagara Falls, are national assets in more senses than one, because they draw together citizens from all parts of the country, and they also amass great wealth in the form of visitors to the localities possessing these wonders.

Therefore the wonders of America should be preserved, not only for sentimental reasons for all lovers of the beautiful, but also for the patriotic and financial reasons.

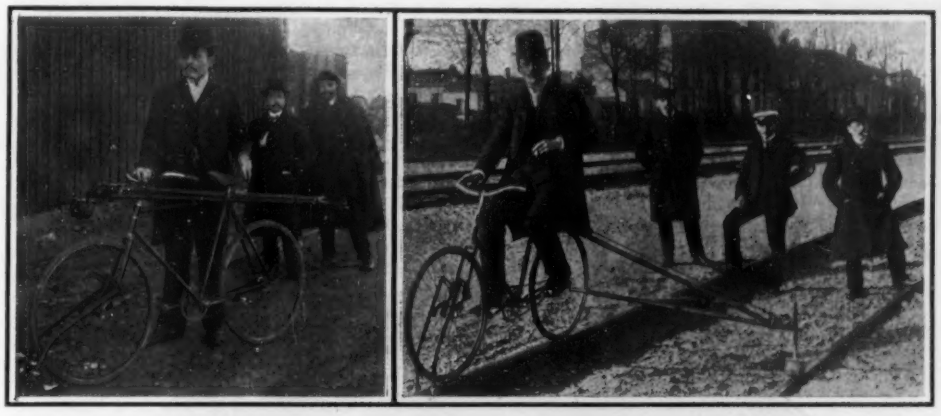
I trust that the SCIENTIFIC AMERICAN may be successful in its good work in stopping any further encroachments upon what is left of the beauty of Niagara Falls.

New York City. PALMER H. LANGDON.

Curiosities of Science and Invention

Track Inspector's Bicycle

IN order to lighten the work of the plodding track-walker a French inventor has designed an attachment for a bicycle which will permit the machine to travel on the rails, thereby allowing the man who inspects the track and roadbed to cover a larger territory in a given time and with much less fatigue. The attachment is shown in the accompanying engravings. It consists of a pair of supplementary forks secured to the main forks of the front wheel and provided at their lower extremities with rollers adapted to bear on opposite sides of the rail. In addition to this there is a light steel frame secured to the main bicycle at the rear which carries at its outer end a small roller that rides on the opposite rail of the track. This serves to keep the two wheels of the bicycle on the rail without any effort of steering on the part of the rider. In order to permit the rider to preserve a comfortable position when traveling slowly around a curve that is steeply banked, the roller is made adjustable under control of a small hand wheel, whereby it may be thrown in or out so that the rider can adjust himself as nearly as he desires to the perpendicular. The roller frame may be detached at a moment's notice and secured to the bicycle in the manner illustrated, and the supplementary forks may be raised, permitting the wheel to be ridden over an ordinary road.



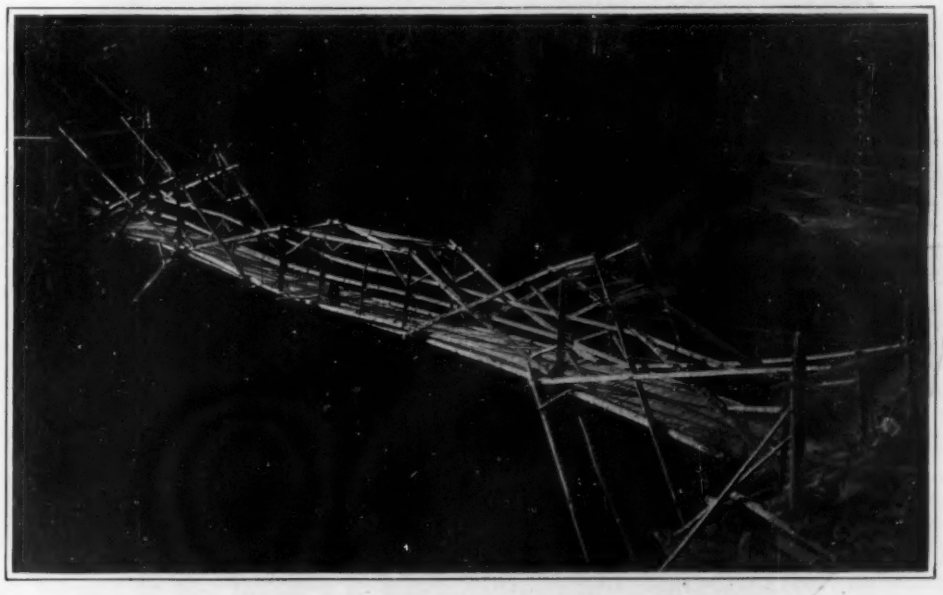
Fitted for road travel. In use on a railroad Track.

A track inspector's bicycle.

A Curious Indian Cantilever Bridge

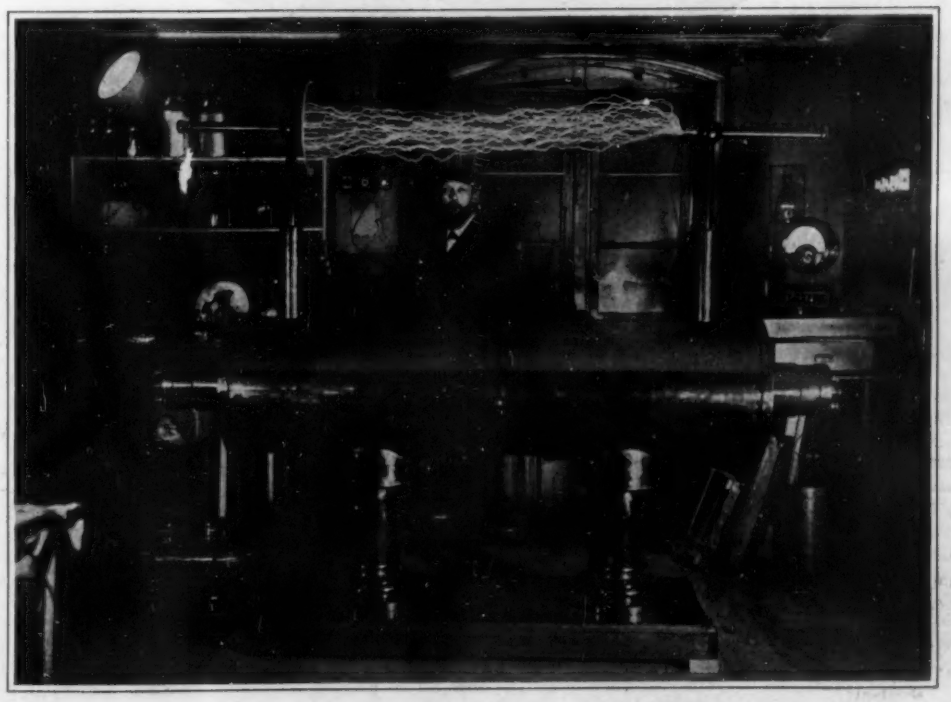
SOME interesting examples of Indian ingenuity are afforded on the River Skeena and its tributaries in north British Columbia. These waterways in their upper reaches flow very swiftly and for the most part through deep ravines. As it is impossible for the Indians to cross them by means of canoes, they have resorted to bridging. Their bridges are interesting structures from the engineering point of view, inasmuch as the cantilever principle is adopted. The bridge of this design shown in the accompanying illustration spans the Bulkeley River where it is about 120 feet wide, and the height from the bridge to water level is about 80 feet.

It is built of wooden logs, the legs of the structure being formed of single stout logs varying from 60 to 80 feet in length. The task of lowering them into position must have demanded considerable ingenuity on the part of the builders. They are buried about 15 feet at their lower ends, and anchored by the superimposition of masses of large rock rolled and carried to the site. The longitudinal members of the shore spans are similarly buried in the ground and lashed to the ends of the diagonal legs. These main members, corresponding to deck girders, are about 120 feet in length, and to either end the A members of the superstructure are lashed. Elaborate cross bracing is resorted to in order to secure greater strength.



Cantilever bridge built by Indians in British Columbia.

When the bridge was first erected the different members were simply secured together by willow thongs, but when the British Columbian government erected a more substantial suspension bridge lower down the river, the Indians assembled and followed the white man's operations with great interest. They observed how the thick wire cables were slung and anchored, and accordingly decided to introduce wire into their own structure. They procured the material for this purpose from wherever they could and introduced it in a most fantastic manner. Also, when the Grand Trunk Pacific Railway engineers commenced working on their track near by, the Indians procured odds and ends, such as bolts and spikes, from them for introduction in their bridge so that now it is a strange looking piece of work, though the fundamental cantilever lines are still distinct.



A giant induction coil discharging across a four-foot gap.

A Giant Induction Coil

THE accompanying engraving illustrates one of the most powerful induction coils in existence, viz., a mammoth apparatus 125 centimeters (49.2 inches) in spark length, constructed for the Vienna Technical High School. A similar apparatus has been constructed for the Potsdam Astrophysical Observatory, both being warranted to stand a potential of 1,000,000 volts.

The discharges of these induction coils comprise the fundamental and upper harmonic vibrations, the minimum and maximum wave lengths being inferred approximately from the length of wire in the primary and secondary circuits respectively. In connection with these giant induction coils the wave length of the fundamental vibrations is about 300 kilometers (186 miles) and that of the highest upper harmonic about 100 meters (328 feet). Their construction is based upon the following voltages between a positive point and negative plate with different distances at the moment of the first spark passage:

Spark length (cms.)—	10	20	30	40	50	60
Voltage—	89	133	178	222	266	300
Spark length (cms.)—	70	80	90	100		
Voltage—	387	473	618	800	1000	

On account of the special winding method contiguous turns of a coil will readily stand a much higher voltage so that their efficiency, owing to the much smaller self-induction, is increased considerably, resulting in those wonderful remarkably substantial discharges which sometimes show the aspect of flames. In fact, the discharges of these giant induction coils carry a considerable amount of electricity.

The Heavens in September 1911

The Comets in the Sky; Location of the Brightest Stars; the Planets

By Henry Norris Russell, Ph.D., Professor of Astronomy in Princeton University

HAD the Moon been in her first quarter, instead of her third, Kiess's comet, which was within twenty million miles of the Earth on August 16th, would have been fairly conspicuous to the naked eye. As it was, the moonlight drowned it out pretty thoroughly. By the beginning of September this comet's rapid motion carries it into 52 degrees south declination, making it quite invisible in our latitude. As it is rapidly receding from the Sun, and still faster from the Earth (owing to its retrograde orbital motion), it will doubtless soon disappear from the gaze even of southern observers.

Brooks's comet—discovered at Geneva, N. Y., on July 20th, by a veteran observer of such bodies—is approaching the Sun, and will not be in perihelion until October 27th. During the early part of September it will be fairly near the Earth (some thirty million miles away) and will be high in the northern sky, and above the horizon most of the night during which time it will be favorably located for observation and may even be visible to the naked eye.

Still a third comet is now in sight—Encke's, which is noteworthy for several reasons. Firstly, it has the shortest period of any known comet, returning to the Sun at intervals of slightly less than three and one-third years. Secondly, it varies in brightness, at successive returns, in a very singular manner, being sometimes easily visible in small telescopes (as is reported at the present return), while at other times, though equally near the Earth and Sun and apparently as favorably placed, it is excessively faint, and can only be observed with powerful telescopes, as was the case at its last return in 1908.

Prof. Blacklund of Palkowa, Russia, who has spent much time in the study of this comet, finds that it always appears faint when it lies in certain directions from the Earth and Sun, behaving as if it was a thin flat disk, almost vanishing when seen edgewise, but fairly conspicuous if not viewed too obliquely.

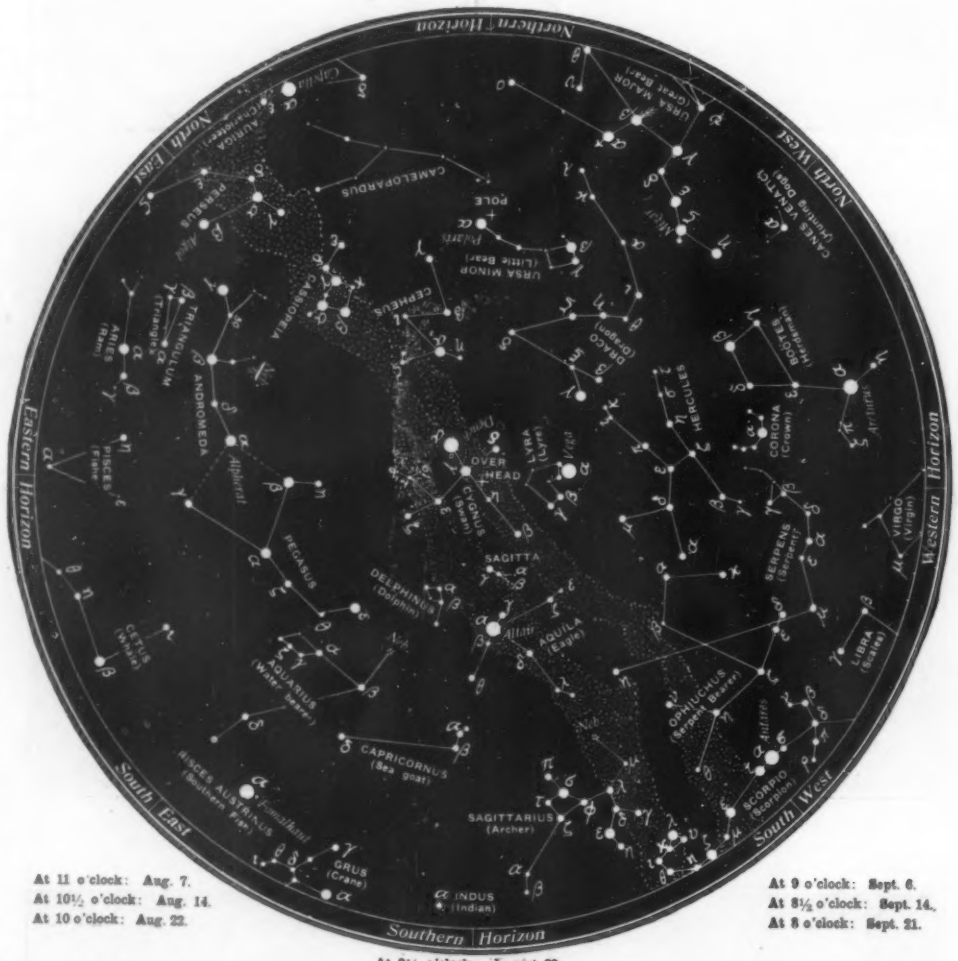
The actual explanation of its changes must be more complete, for, like other faint comets, this one appears as a roundish mass of light. It would be possible to explain the facts by assuming that the comet was composed of a great number of separate particles all strongly flattened parallel to the same plane; but some less artificial explanation will doubtless in time be available. Third among the peculiarities of this comet, and most interesting of all from the theoretical standpoint, is the fact that its period of revolution is decreasing. This proves that some force, other than the attraction of the Sun, must act upon it, for otherwise, like the planets, it would always take exactly the same time to complete a circuit of its orbit. The attraction of the planets themselves would indeed give rise to slight differences in the duration of successive revolutions; but when the laborious calculations necessary to determine these "perturbations" have been carried out, and checked so as to exclude any chance of error, it is found that there remains an unexplained shortening of the comet's period.

It is one of the apparent paradoxes of theoretical astronomy that the return of a comet *earlier* than the predicted time (provided this can be accurately determined) means that some force has been at work which has *retarded* the comet's motion. A full explanation cannot be given by elementary methods; but the principle involved is this: The retarding force decreases the rate of the comet's motion, as might be expected; but the Sun's attraction acting on the now slower moving comet draws it into an orbit smaller than before—so much smaller, indeed, that even at the slower speed it gets round it in less time than formerly.

By refined methods, taking into account the change in the form of the orbit, as well as the period, it is possible to discriminate between the influence of a minute retarding force acting steadily all along the comet's orbit, and a more powerful one exerted along only a part of it. In this way Blacklund comes to the conclusion that the resistance acting on Encke's Comet is concentrated in a relatively small region in the part of the orbit nearest the Sun. Its actual amount is, however, so small that the retardation cannot be detected by direct observation immediately after the comet leaves this region. It is only at the following return when the cumulative results during the whole following period become evident, that the extent to which the comet has been retarded can be calculated.

Still another curious circumstance must be mentioned. The amount of the retardation is not always the same. In the middle of the last century the period was shortened by about two and a half hours in each revolution; but since then the influence was twice abruptly diminished. Prof. Blacklund is inclined to explain this by supposing that the comet's motion is hindered by passing through a cloud of meteorities—or something of that sort—which is not of the same density at the successive times when the comet strikes it.

Enough has been said to show what an interesting body this little comet is to the astronomer. Accurate observations are now secured for as long an interval as possible at each return, and great mathematical skill, and enormous labor in computation, expended in the calculation of its motion; but it may still be long before the nature, and especially the variations, of the strange resistance to which its motion is subjected are fully comprehended.



At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.

At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

At 9½ o'clock: August 29.

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens.

Turning now to our map of the evening skies, we find that the splendid Cygnus right overhead. To the west is Lyra, with the resplendent star Vega, and southward shines the less luminous Altair. A brilliant region of the Milky Way, below this, leads us to Sagittarius and Scorpio—the latter almost setting in the southwest. Ophiucus and Serpens are farther to the right; then Hercules, Corona and Boötes, in an almost vertical line below Lyra. The Great Bear is well down in the northwest, with the Dragon and the Little Bear above. The vacant region below the pole on the other side contains the modern constellation Camelopardus—made to fillI a gap between the ancient ones. Farther to the right, in the Milky Way, is another fine series of star groups—Auriga, just rising, then Perseus, next Cassiopeia, with the less brilliant Cepheus between her and Cygnus.

The great square of Pegasus is well up in the east. Andromeda is on the left, and Aries below. A few stars of Cetus have risen to the south of east. About southeast is a bright star, which from its southern declination and isolation is at once recognizable as Fomalhaut, the only conspicuous member of the constellation of the Southern Fish. Above this is Aquarius and farther to the right Capricornus.

Though one of the fainter zodiacal constellations this last is a fairly definite group of stars, and can easily be made out on a clear night.

Its principal stars which bear the Greek letters Alpha and Beta, are close together in the northwestern part of the constellation, at the head of the Sea-Goat, as our initial shows. About 20 degrees to the eastward the monster's tail is marked by the stars Gamma and Delta Capriconi, the latter, though fourth in alphabetical order, being the brightest in the whole constellation. A slightly curved line of faint stars, only conspicuous when there is no moonlight, connects these two groups, and two similar lines run downward from them, forming a triangle whose third vertex is marked by two stars (in the Goat's fore paws) which, though not much fainter than those already menbear the last letters of the Greek alphabet—Psi and Omega.

Alpha Capricorni is a fine naked-eye double star, with components 6¼ minutes of arc apart. Beta Capricorni is also a wide double, but as the components are very unequal in brightness and separated by but 3½ minutes of arc, the aid of a field-glass is needed to see them separately.

The Planets.

Mercury is evening star at the beginning of the month, but is too near the Sun to be seen. On the 9th he passes through conjunction, and thereafter is a morning star, reaching his greatest western elongation on the 25th. About this time he rises at 4:30 A. M. and can easily be seen.

Venus is also in conjunction with the Sun on the 15th and changes from evening to morning star. She can only bs well seen toward the end of the month,

(Continued on page 217.)

Abstracts from Current Periodicals

Phases of Science as Other Editors See Them

Meteor Trains

IN the *Popular Science Monthly*, August, 1911, Prof. C. C. Trowbridge, of Columbia University, presents a summary of the results thus far obtained in his study of meteor trains, which he has now carried on for a number of years, and which he has made the subject of several earlier contributions to the scientific journals. His activity in this field of research has been recognized by the National Academy of Sciences, which has made him a grant from the J. Lawrence Smith Fund, to enable him to extend his work in this direction.

Prof. Trowbridge applies the term "persistent train" to a meteor trail of long duration—from several minutes to an hour or more—as distinguished from a trail lasting, at most, a second or two, such as is ordinarily seen in the wake of a meteor. A large number of these persistent trains have now been observed and measured, and their altitudes have in many cases been determined by simultaneous observations at two or more stations. They average about ten miles in length. They are at first straight narrow streaks, but gradually expand to a width of a mile, and become curved and twisted into various shapes, as they are drifted by the wind. These transformations are illustrated in the accompanying drawing. *A* shows the appearance of a train a few seconds after the nucleus of the meteor had disappeared. Soon after its appearance the train was sixteen to eighteen miles in length and at an altitude of fifty-six miles above the earth, as determined by triangulation from Sidmouth and Cardiff, which are fifty miles apart. It appeared lance-like for a few moments and then was seen to be bending like a floating ribbon, and also expanding in width, until it assumed the appearance shown at *B*.

A meteor having a remarkably persistent train appeared over the south of England at 7:30 P. M., February 22nd, 1909. The train gradually increased in brilliancy, and twisted about, assuming grotesque shapes. A part of it drifted to the northwest at a velocity of 80 miles an hour, and remained plainly visible until 9:30 or 10 o'clock; i. e., over two hours. Another part drifted much faster; viz., at the rate of 300 miles an hour, according to the calculations of Mr. Denning, the well-known English authority on meteors.

Popular Science Monthly.

Meteor train seen at Sidmouth and Cardiff, England.
Observed on November 14, 1866, at 1:08 A. M. Visible until 1:20 A.M.

Prof. Trowbridge finds that the altitude above the earth's surface at which persistent meteor trains occur when seen at night is usually confined to definite limits between forty-five and sixty-five miles; though the path of the meteor may extend far above and below these limits. He terms this stratum of the atmosphere the *meteor train zone*. He assumes therefore, that in this zone there are conditions favorable to both the formation and the persistence of the luminosity of the trains, and he believes that the principal condition is the pressure of the atmosphere at that particular elevation.

He explains the train as a phenomenon of luminescence, similar to the afterglow following an electric discharge in a vacuum tube. When a body is very hot an immense number of negatively charged corpuscles or ions are given forth from it. Air containing free ions becomes a conductor of electricity, hence we have in a meteor rushing through the atmosphere a condition very like a long electrical discharge tube containing a gas at low pressure; the passage of the meteor forming a column of highly ionized air thirty or forty miles in length.

Experiments with vacuum tubes containing air of about the same density that is supposed to occur at the altitudes in question, and from which the oxygen has been mostly extracted, give the same slowly-fading afterglow, following an electric discharge. Thus, according to Prof. Trowbridge, it is not unlikely that the production of the light of a meteor train is connected directly with the highly ionized state of the air produced by the outpouring of electrons from the intensely heated meteor.

The rapid lateral expansion of the train is explained as due mainly to gas diffusion, and the rate of such diffusion depends upon the pressure and the temperature of the gas. Accurate observations of the expansion of these trains should therefore aid in determining the pressure and temperature of the atmosphere at the altitude at which the train occurs. Further the drift of the train furnishes a means of determining the direction and speed of the air currents at these great altitudes, which are far beyond the range of meteorological balloons.

Whatever may be thought of Prof. Trowbridge's explanation of the physical nature of meteor trains, it is clear that their systematic observation should be considered a most important part of the general campaign of upper air research which is now engaging the earnest attention of meteorologists and astrophysicists.

The Odor of the Rainbow

EVERYBODY has heard of the pot of gold buried at the end of the rainbow, but there is another old belief connected with this meteor that is not so familiar nowadays. The attention of meteorologists was called to it, a few years ago, by Mr. Richard Bentley, of the Royal Meteorological Society.

It appears that over half a century ago a controversy took place in the English newspapers as to whether the rainbow emitted an odor. A belief in such an emanation existed in antiquity, and has been echoed by several modern poets. Thus it is mentioned in Pliny, Aristotle, and a Greek writer referred to by Coleridge, in his "Table Talk"; in the "Peripatetic Philosophy" of Georgius de Rhodes; in Bacon's "Sylva"; in Browne's "Britannia's Pastorals," and more lately in a poem by Robert Snow.

The origin of this curious belief is explained by Mr. Bentley as follows: Everyone is familiar with the increase of scent given off by plants and shrubs on a warm evening after the air has been newly washed by rain. This would naturally often coincide with the appearance of a rainbow.

A New Miniature Projection Apparatus Suitable for Legal Photography

THE photographic work of experts in criminology is carried out usually with the aid of artificial light, at least when microscope objectives are used. In these cases the surface to be illuminated is usually only an inch or two wide; but the illumination must be intense and very uniform. The small projectors which are used by physicians for the examination of the eye and throat are ill suited for this purpose. A writer in *Die Umschau* describes Geiger's new miniature projection apparatus, which may be used for photography as well as for other purposes. As the accompanying illustration (Fig. 1) shows, the apparatus consists essentially of a stand carrying a resistance box and the lamp with its housing and projecting lenses. The lamp is a self-regulating, or fixed point, electric arc, which consumes about 3 amperes of current, can be used on ordinary incandescent circuits and yields an exceedingly uniform light of about 300 candle power. The two projecting lenses are mounted in a draw tube, by extending which more or less the diameter of the illuminated circle may be varied from an inch or two to twelve inches. Even with the largest circle the illumination is sufficient for photographic purposes. The size of the circle can also be limited by the use of diaphragms. The lamp can be moved vertically and horizontally on the stand, and the upper part of the stand carrying the lamp, can be inclined at any angle by means of the joint and screw shown just below the resistance box. The projector is also provided with a mirror which can be turned and inclined in any direction. By means of these various adjustments the dimensions and direction of the cone of light can be adapted to any purpose. This flexibility of the apparatus will be found especially valuable when the working space is limited.

This apparatus will be found very useful for scientific photography in many fields. Here we will mention only its employment in photographing the so-called latent finger marks which are often used for the identification of criminals. Although these marks are called latent, they are not strictly invisible, but only difficultly visible, that is to say, a special kind of illumination is required to make them sufficiently conspicuous to be photographed. Various devices for producing such illumination are described in special treatises. Among these methods that of Stockis is the most successful, but it requires a special projection lantern, the mounting and adjustment of which are troublesome and tedious. The writer has obtained excellent photographs of latent finger prints on glass with Geiger's miniature apparatus, arranged as shown in Fig. 2. A camera *C* with an objective of long focus and a correspondingly long bellows, is placed with its lens at the distance of twice its focal length from the piece of glass, *gg*, bearing the finger marks. The projector *S* is placed in an inclined position with its mirror almost in contact with the lens of the camera, so that the narrow conical pencil of light is nearly perpendicular to the surface of the glass and nearly coincident with the optical axis of the camera. With this arrangement the papillary ridges of the

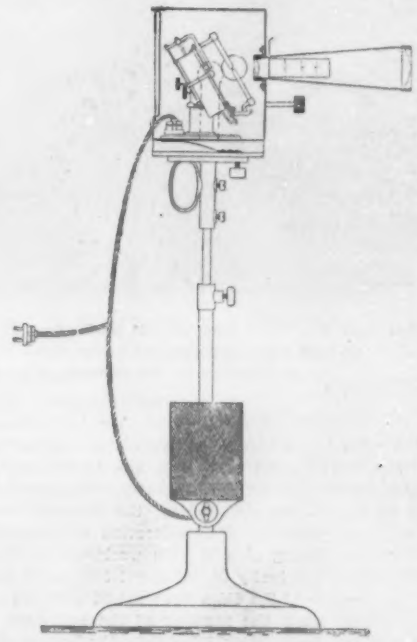


Fig. 1.

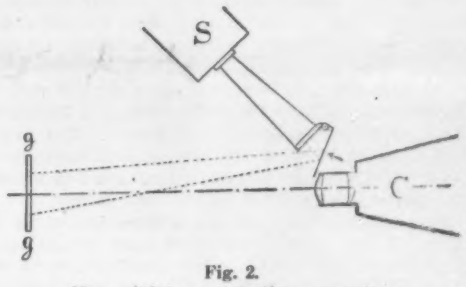


Fig. 2.
New miniature projection apparatus.

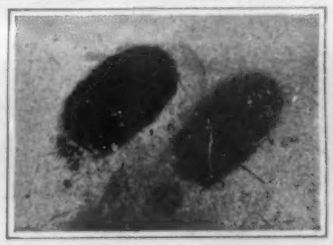
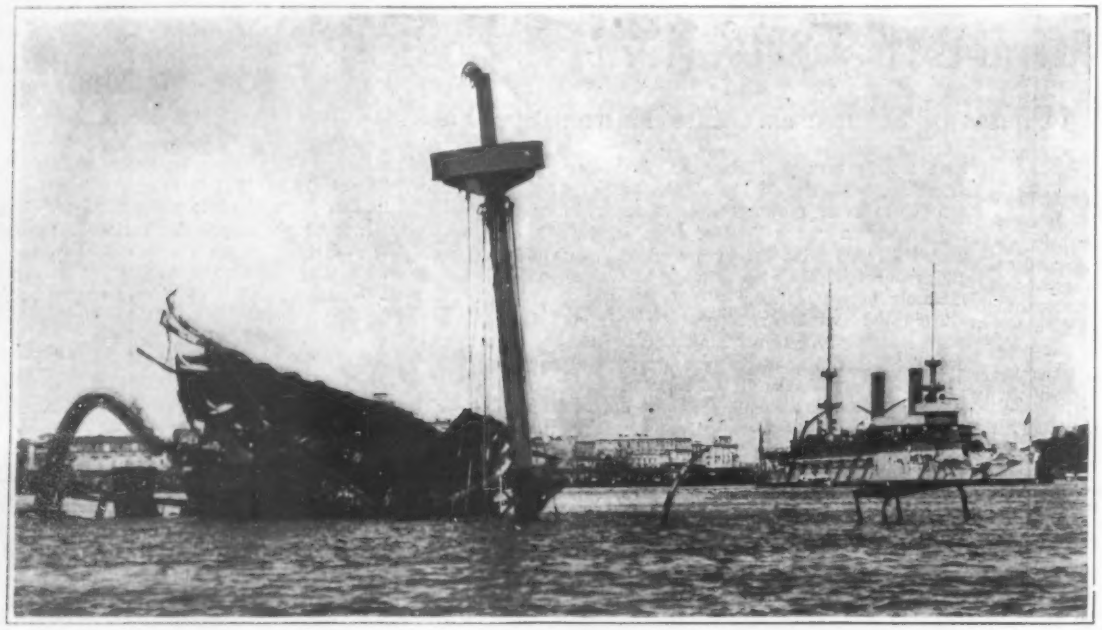


Fig. 3.
Photographs of finger prints obtained with the new miniature projection apparatus.

finger impression are intensely illuminated and appear on the positive photograph as white lines on a black ground. Figure 3 shows a negative impression contained directly in the camera on bromide paper by this method. This negative shows the papillary lines black on white ground, and is hence directly comparable with the impression of the blackened finger on paper. The great simplicity of this method should lead speedily to its general employment in criminal practice.



This view was taken from off the port side. To the left is a boat crane. Abaft is a portion of a deck, which was blown up and back, exposing its under side. Abaft of this is the mainmast. The projecting material to the right is standing on the submerged poop decks. Beyond this is the "Kentucky" or "Kearsage."

THE "MAINE" AS SHE APPEARED AFTER THE DISASTER

THE work of raising the wreck of the "Maine" from its thirteen years bed in Havana harbor has now progressed to such an extent that an intelligent idea may be had of the undertaking, the force of the explosion and permit of a consideration of the caisson or cofferdam being used in this work.

The wreck originally lay in about 35 feet of water, but the actions of the tides have raised the mud level over 5 feet, while the remains of the hull have settled into the mud about 35 feet. As the bottom of the wreck is not less than 60 feet below sea level, the caisson must finally sustain a pressure of 30 feet of water and 30 to 35 feet of mud before the hull of the vessel will be exposed either for examination or removal. The original idea of the engineers in charge of the work was to pump out the water and mud to this level, to uncover the entire wreck and determine, if possible, the cause of the explosion. The recent developments of the works have made it necessary to modify these plans, because the caisson has not developed the estimated strength.

The design of this caisson is somewhat of an innovation and must be considered more or less as an experiment, this being the first practical test on any large undertaking. It has not proved an entire success, and whether the defects that have developed can be remedied and this system perfected for future use is a matter for the engineers and the owners of the patents to determine, but from the results obtained in Havana the system does not seem quite feasible.

The caisson consists of twenty steel cylinders about 50 feet in diameter, constructed around the wreck in an eliptical form. Each cylinder must be considered more or less as an independent unit, as there is a foot of space between each of the cylinders, which space has been closed in on the outside line by a 15-foot segment of a cylinder, and on the inside with a wooden pile. The cylinders are built of 150 straight, steel, interlocking staves, about 75 feet long. The staves were driven one at a time around circular forms with insufficient false work, and care was not used in the driving to keep them plumb, the result being that the top of the circle was completed sooner than the bottom, which spread in many cases as much as 24 inches, and in a few others even more. The last stave driven, which completed the cylinder had to stand the strain of closing in the open space and drawing the bottom circle into line with the top. The interlocking jaws of the staves in some cases could not stand the strain and have splintered and cracked.

As soon as all the cylinders were in place they were filled with earth dredged from the harbor. The filling of the cylinders became necessary to make the joints between the staves watertight and to prevent the steel shell from crushing under the water pressure. The strength of the caisson is derived from the earth confined within the cylinders. What this strength will be is an open question. Where the caisson would fail

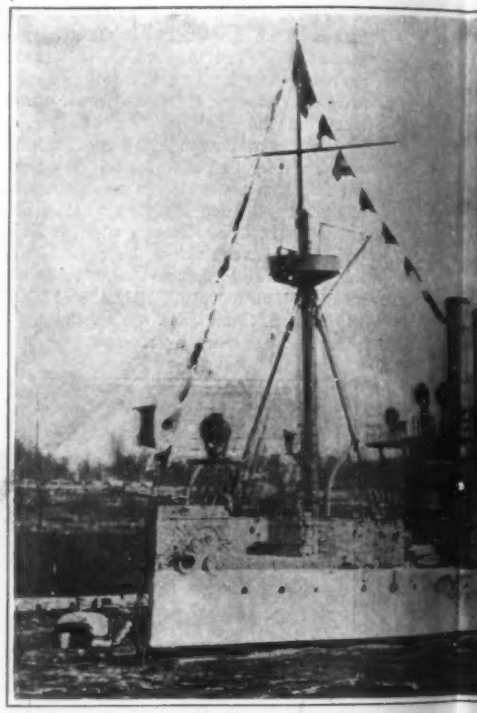
The Mystery o

Searching for the C

By Ludwig

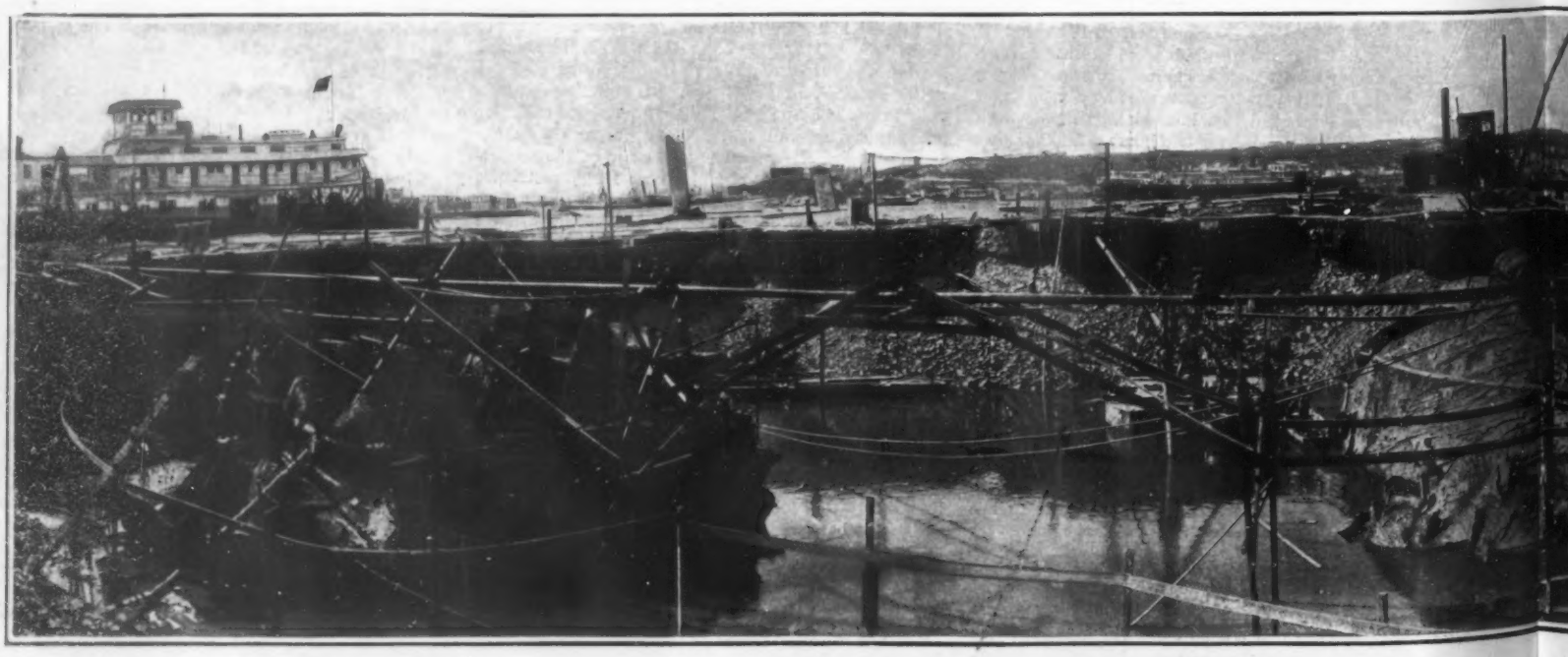
(Special Correspo

["I was just closing a letter to my family when I rending and crashing sound or roar of immense volu ceeded by a metallic sound—probably of falling debr then an impression of subsidence, attended by an within the cabin. I knew immediately that the Ma hurried to the starboard cabin ports, thinking it m way. Upon looking out I decided that I could go by fore took the latter route, feeling my way along and ture was filled with smoke, and it was dark. Neamin orderly at the cabin door at the time. He ran into and reported to me that the ship had been blown up the Naval Court of Inquiry into the Maine disaster. written above these photographs showing the ill-fate waters of Havana Harbor.—Ed.]



The "Maine" in these days would be accounted an insignifica and 17.4 knots speed; carrying four 10-inch and six 6-inch

THE "MAINE" AS SHE APPEARED SH



Copyright 1911 by American Photo Company, Havana.

What is left of the bow, with portion of deck thrown up and back upon it with under side exposed.

This gap shows the region of the explosion. It represents the explosive energy of the 10-inch an 6-in magazines; which blew out the sides, lifted the decks and folded them back upon the ship

PANORAMIC VIEW SHOWING "MAINE" WRECK AND THE

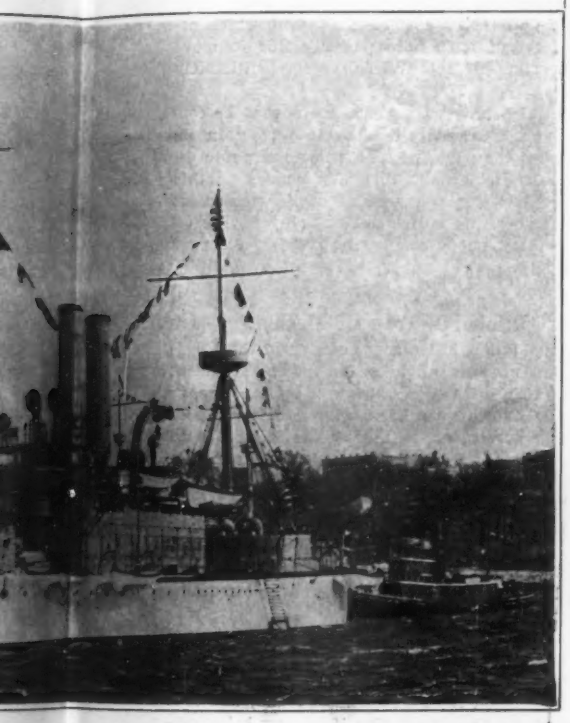
tery of the "Maine"

or the Cause of the Explosion

By Ludwig Diller, C. E.

Special Correspondent at Havana)

family when I felt the crash of the explosion. It was a bursting, f immense volume, largely metallic in its character. It was suc- of falling debris—a trembling and lurching motion of the vessel, tended by an eclipse of the electric lights and intense darkness y that the Maine had been blown up and that she was sinking. I thinking it might be necessary for me to make my exit in that I could go by the passage leading to the superstructure. I there- ıway along and steadying myself by the bulkheads. The superstruc- dark. Nearing the outer entrance I met Private Anthony, the . He ran into me, and, as I remember, apologized in some fashion, been blown up and was sinking."—So testified Capt. Sigsbee before aine disaster. It is fitting that his dramatic story should be re- ing the ill-fated ship as, thirteen years later, she emerges from the



ed an insignificant ship. She was 318 feet long, of 6,682 tons displacement and six 6-inch guns. She carried twelve inches of armor amidships.

PPEARED SHORTLY BEFORE HER DESTRUCTION

The caisson consists of twenty more or less independent steel cylinders about 50 feet in diameter, constructed around the wreck in elliptical form. As soon as all the cylinders were in place they were filled with earth dredged from the harbor.

A SECTION OF THE CAISSON

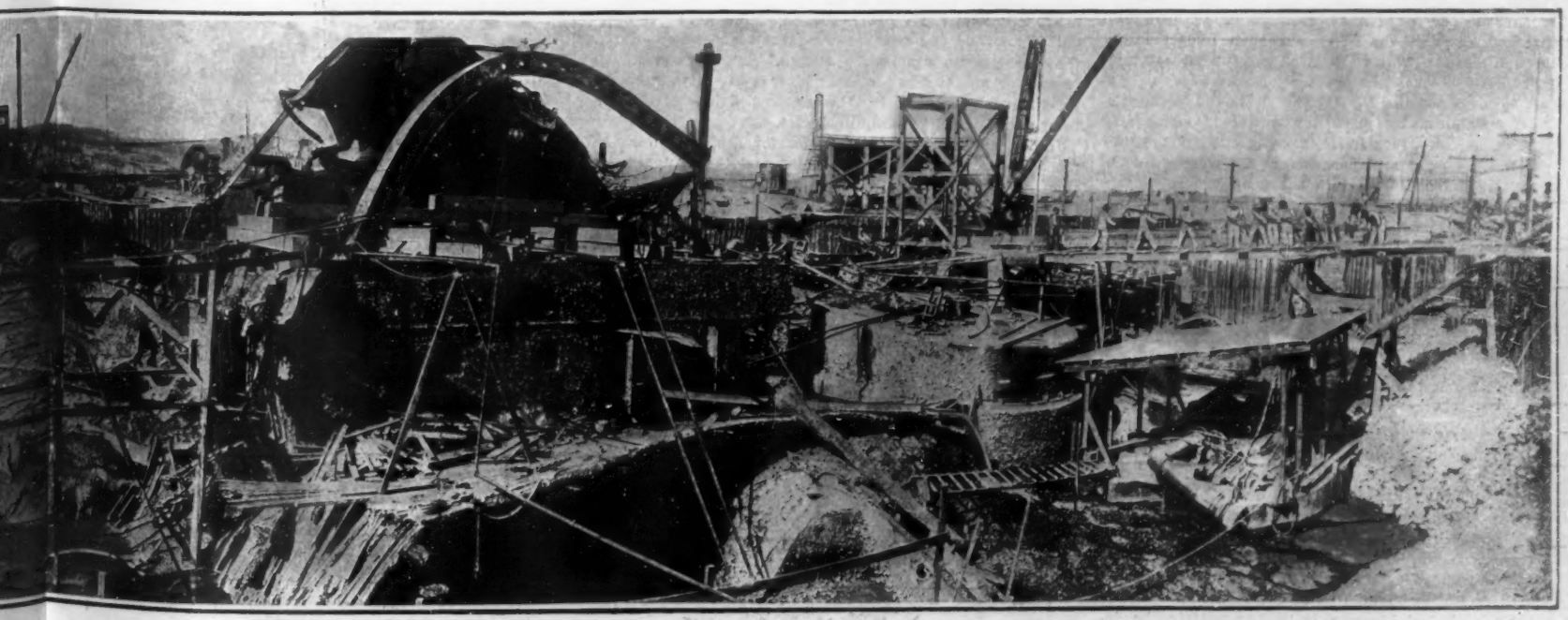
if tested to the breaking point is hard to say. There must be at least 10 or 15 feet of slime and soft mud in the cylinders at the level of harbor bottom. The caisson is, therefore, weakest at this point where the water pressure is greatest, so failure might be expected at about 30 or 35 feet below sea level, or at the bottom of the harbor, provided a cylinder did not become detached and forced out of place.

When the caisson was completed and filled, the water was removed by degrees until a 15-foot level was reached before any signs of stress developed. At this point a thorough examination was made which showed that the various cylinders were moving, those of the side faster than those on the end; that the caisson, owing to the space between the cylinders, was not a complete unit, but composed of twenty separate parts each one acting independently. Besides this an examination below water by the divers showed that the staves of the cylinders were strained as mentioned above, and that they required immediate reinforcing. The water level was at once raised about 5 feet and maintained at the 10-foot level, while the caisson was being strengthened.

Seventy-five thousand tons of stone and rock have been dumped within the caisson and banked against the cylinders. This stone, of course, has sunk in o the mud and raised it from about 30 feet to 22 feet below the sea level, so the wreck to-day is buried in about 40 feet of mud. The stone fill has strengthened the caisson, but has not stopped the movement of the cylinders. Many of them are 3 to 4 feet out of plumb, inclining toward the center. The original movement of the cylinders, before the stone fill, under the pressure of the 10-foot water level, was 1½ inches in 24 hours, while now with the rock reinforcement and with the water removed to the mud level, or about 22 feet below the sea level, the movement has been reduced to about ½ inch in 24 hours.

The stone reinforcement encroaches upon and banks against the bow and stern of the wreck, while in the wider parts of the caisson the wreck is still entirely free. As the 40 feet of mud is being removed from the line of the wreck, the weight of the stone will force the mud from beneath the stone, thereby causing it to settle deeper and deeper into the caisson. This will require additional stone reinforcing, as the reinforcing must be maintained around the top of the cylinders, to prevent them from toppling over. As the volume of the reinforcement is increased the embankment will encroach more and more upon the wreck.

To correct this evil at the bow and stern it has been found necessary to place a single line of steel sheet piling as close to the wreck as practical, to retain the mud and stone against the cylinders, and prevent any further encroachment upon the wreck. This sheet piling will have to be braced to the wreck itself to withstand the pressure from the caisson, while the mud is being removed.



inch an 6-inch he ship

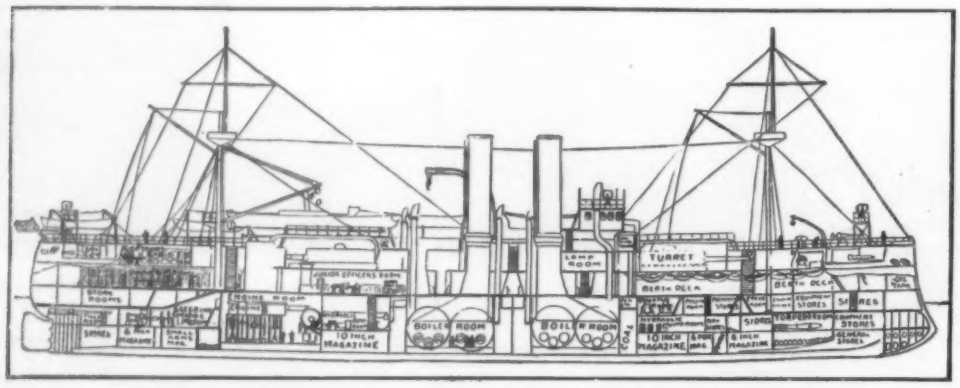
The central superstructure, with portion of deck folded back upon it. Note barnacle-encrusted side of ship with its square portholes.

The after turret with two 10-inch guns all intact.

Poop deck with portholes shutters still raised.

K AND THE COFFERDAM WALL WITH ROCK FILLING AT ITS FOOT

A summary of the work, as it stands to-day, seems to show that the caisson is constructed of twenty separate units, which lack sufficient strength to withstand the pressure until filled; that the fill is of a nature not to withstand much pressure; that the cylinders were strained in placing, and that an additional row of sheet piling is required to keep the reinforcement free of the wreck. The caisson has proved not only inefficient, but very expensive. The first appropriation of half a million dollars was expended some time ago when the work was only half finished, and another half million will be required before the work is completed.



This longitudinal section of the "Maine" shows the location of the magazines.

While the caisson cannot be considered an engineering success, it has permited of the removal of the remains of our "hero dead." There are still many bodies unaccounted for and always will be, because the force of the explosion blew them free of the wreckage and into the harbor, but all the bodies confined within the wreck can and will be recovered. On August 12th the cruiser North Carolina arrived in New York harbor with the remains of Lieut. Merritt, one of the two officers who lost their lives. After all the remains have been recovered they will receive a fitting burial, with all the honors due brave and true men.

The cause of the explosion will never be learned. If it was primarily of an external origin there will be no traces of it found to-day. The forward magazines have exploded and the hull is practically cut in two. The bridge and the conning tower with part of the decks and hull have been turned completely upside down and folded back upon the main deck amidship, while the bow is turned completely inside out and is a mass of unrecognizable junk. For a space of about 100 feet between the wreck of the bridge and the bow, soundings in the mud fail to show any trace of the hull. From midship to the stern the wreck is practically intact and can be raised without difficulty by building a bulkhead back of what was the bridge. The bow will have to be removed piece by piece by cutting the wreckage apart with acetyline torches. A plant for this work has been installed, with torches that cut through the steel wreckage like a knife through cheese. This work is already under way and part of the wreckage has been removed.

A wooden model of the "Maine" is in the engineer's office and piece by piece the model is being dismantled as the wreck itself is being cut apart. Several months must still pass before the wreck will be ready for its final burial in the deep waters of the sea, and the last visible sign of the wreck of the "Maine" will have been destroyed forever, excepting only such parts as the government may preserve for fitting memorial monuments to those who, without a moment's warning, were sent into eternity by the explosion of the ship's magazine, the cause of which will forever remain unknown.

The Technical Museum of Vienna

THE Technical Museum in Vienna publishes a circular stating that, in commemoration of the sixtieth anniversary of Emperor Francis Joseph's reign, Austrian manufacturers with the assistance of the State and the City of Vienna initiated this new museum. The foundation stone was laid on June 20th, 1909, and the building, which covers an area over 20,000 square yards, and which is situated opposite the palace of Schoenbrunn, is now nearing completion and will be a lasting monument of the monarch.

This Technical Museum is to demonstrate the development of industries and crafts in historical succession, also to do justice to the technical achievements of the present day, and to promote progress in this line by periodical exhibitions. It is to be a public educational center spreading the knowledge of the scientific foundations and the national economic aims of technical pursuits.

A considerable stock of objects has already been secured, as several large and valuable state collections, till now dispersed, are shortly to be brought together there. But many links in the chain of technical development are still missing. Therefore technical scientists, manufacturers and craftsmen of all countries are invited to co-operate in this great task and to assist the museum in procuring and selecting suitable objects. Everything pertaining to technical labor is acceptable, principally tools, machines, apparatus, models, materials, methods of working, finished articles, as well as plans, designs, books, illustrations and manuscripts. The Austrian government has placed at the exhibition's disposal the halls of the Rotunde ("Prater") for the present storing and sifting of arriving donations. The names of donators will be perpetuated by inscription on the gifts and in a memorial book. Further particulars can be obtained from the office of the Technical Museum, Vienna, I. Ebendorferstrasse 6.

Destruction of Banknotes

IT WILL come as a surprise to those whose chief difficulty in regard to banknotes is to be able to keep them to learn that there are yet others for whom the difficulty is how to get rid of them. Yet this is quite true in the case of those who have to destroy in bulk paper which has been used in representing money values. The difficulties thus encountered in destroying such paper are well illustrated by the experience of the German imperial printers.

In this case the difficulties experienced are further increased by the necessity of coping with very large quantities of waste, for in addition to that arising from printing there is also that of stamp paper spoiled in the gumming as well as faulty water-marked paper.

The methods previously available were three—burning, boiling and pulping. In the first process it has been found even where a special furnace has been used, it has not infrequently happened that while the outer parts of the packets were destroyed some of the contents were not even singed. In the case of stamps or gummed paper the matter was still worse, for the packets baked together into solid blocks, the interiors of which were quite intact.

In the second process the paper for destruction is placed in iron boilers; lye is added and the contents then subjected to the prolonged action of steam. As a destructive process for small quantities this is most effectual, as is also that of pulping, a process in which the paper is cut up by revolving knives in water. In both of these cases there is, however, another difficulty, that of disposing of the product. It cannot be easily sold, it will not pay to transport and on hand the sodden stodgy mass quickly "goes bad."

The German imperial printers therefore decided to try a new way—grinding it up dry. To this end they installed a 40 horse-power Schlagkreuz mill, which by a process of hurling, crushing and tearing reduces the paper to an almost powderlike form in which it passes through a sieve into a collecting chamber beneath the mill ready for packing. This, however, was accompanied by a very objectionable feature, especially when dealing with gummed paper in the grinding—such a dust was created that though the workmen engaged wore protectors, it yet persistently filled and blocked their eyes and nostrils.

As the work of packing was on this account not only unhealthy, unwillingly performed and also uneconomical, efforts were made to find some mechanical means of doing it. Simple as this had seemed at the outset, later it appeared a problem almost insurmountable. Difficulty after difficulty arose. Among such may be mentioned that a spiral feeder having been devised it was found that the paper would some times form into balls as solid as blocks of wood, which defied the efforts of a 20 horse-power motor to move them. Nevertheless this difficulty was ultimately overcome.

The imperial printers, therefore, are now to be congratulated upon possessing a machine perfect in its kind. It takes the paper, grinds it up to any size desired and bags it. Finally though the paper in this form fetches but little on account of its consequent shortness of fiber, the mill is yet not only paying off the initial outlay, but is also saving some $250 a year in workmen's wages.

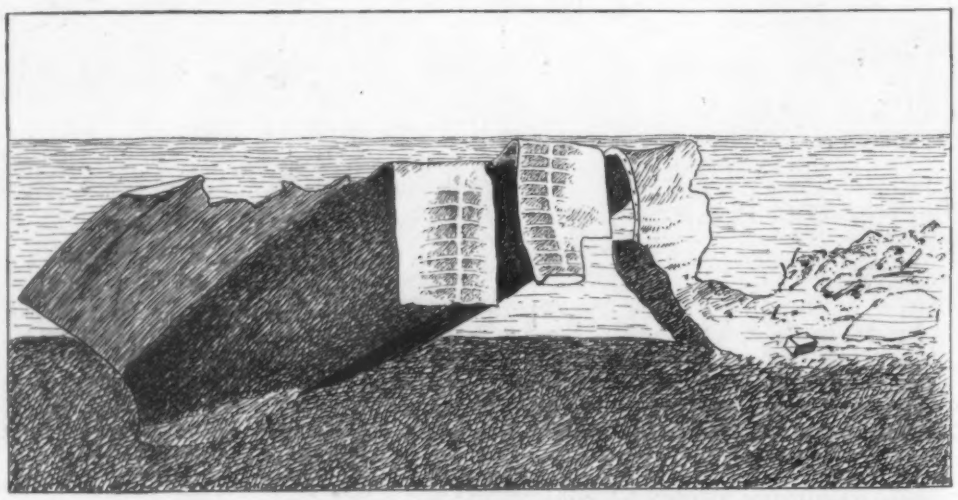
A National Bureau of Markets

ON August 14th a bill was introduced in the House of Representatives providing for the establishment of a new branch of the Department of Agriculture, to be known as the "Bureau of Markets." The duty of the proposed bureau, as defined by the bill, is to be "to make diligent investigation of the methods of marketing farm products, and especially with regard to finding out and recommending the fairest and most direct method by which farm products may reach the consumer from the producer, by accumulating and distributing information on the subject in question and on the subject of the best methods and best markets for selling."

While the language of the bill is somewhat confused, it is evident that a step of much economic significance is contemplated. It is the order of the day to throw light upon the mechanism of trade; and it is in harmony with the progressive ideas now being conspicuously fostered by the International Institute of Agriculture to bring scientific methods to bear upon the marketing of farm products. We believe that a work of far-reaching beneficence awaits the Bureau of Markets, and hope that Congress will see fit to give it being.

Tramways in Monte Video

ACCORDING to a Consular Report, the United Electric Tramway Company of Monte Video, which was formed and registered as a British company in 1904, owns and works 131 kilometers—82 miles—of lines in Monte Video, with 195 motor passenger cars and 68 trailers.



Redrawn from a picture in the Report of the Naval Court of Inquiry upon the Destruction of the U. S. Battleship "Maine."

Wreck of the "Maine" as disclosed by divers in 1898.

The Inventor's Department

Simple Patent Law; Patent Office News; Inventions New and Interesting

The Doutre Automatic Stabilizer

THE all too numerous accidents to aviators place the question of automatic stabilizers in the very forefront of interesting inventions. The ideal equilibrator would be one which would act in two directions, both laterally and longitudinally. Many attempts along this line have been made but hitherto have proved unsatisfactory. A very interesting new departure is a stabilizer invented by M. Doutre. This stabilizer has been installed upon a Farman biplane actuated by a 60-H.P. Renault motor. The well-known aviator, Didier, flew with the machine first alone and then with a passenger, and performed several flights which demonstrated the efficacy of the apparatus. In one trial the machine flew very successfully in a 36-mile wind.

The Doutre stabilizer acts upon the longitudinal equilibrium only. Under three conditions this equilibrium is affected, viz., by the slowing down of the motor, gusts of wind from the front, and gusts of wind from behind, which cause the machine either to rear or plunge to the ground.

To overcome the pitching, the aviator must turn the elevator in the direction of the pitching. But the pilot has not always the presence of mind nor even the time to carry out all these movements. The automatic stabilizer, it is claimed, claims to fulfill these functions spontaneously.

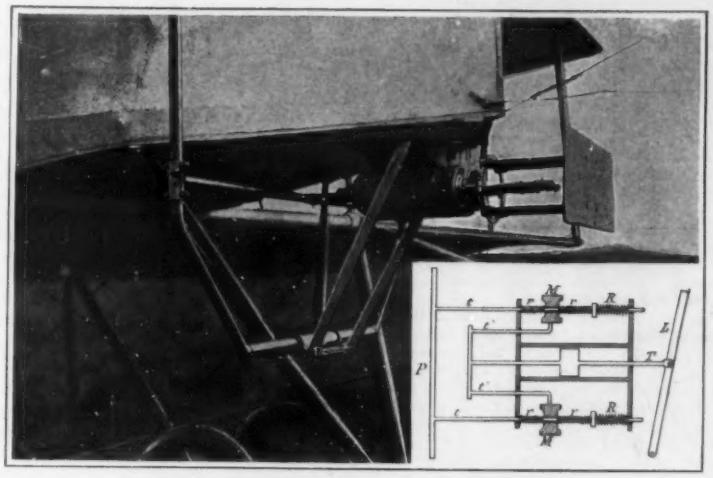
The stabilizer comprises two essential parts: First, a plane surface, moving a vertical plate in a sliding frame, and presenting its face to the wind, which causes it to recede more or less according to the intensity of the wind. This plate practically constitutes an anemometer which responds to the pressure of the relative wind. Secondly, there is a member which follows the displacements of the plates and transmits them through a system of joints to the horizontal rudder or elevator.

The movable resisting surface is a rectangular aluminium plate supported upon rods which slide in the frame of the machine, being maintained in a fixed position through the tension of a spring when the wind is normal. If the relative wind increases, the aluminium plate moves back in proportion to the resistance and returns to its former position as soon as the excess pressure disappears. Similarly, in case there is too little pressure, the aluminium plate moves forward under the action of the spring.

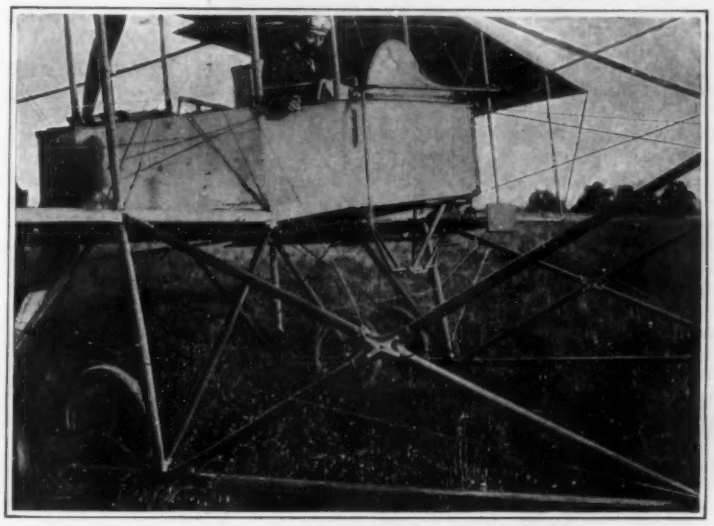
The sliding rods of the aluminium plate are connected with a central rod *T* which enters the cylinder of the compressed air auxiliary motor, controlling the piston of the same; it passes out of the other end of the cylinder, and actuates a lever *L* which controls the horizontal rudder of the aeroplane. It will, therefore, be understood that when the springs and lever joints are suitably adjusted, the movements of the aluminium plate under the action of the relative wind cause the admission of compressed air into the auxiliary motor, in proportion to the displacements of the piston rod, in one direction or the other. In this way, through the intermediary of the rear rod, the horizontal rudder or elevator is automatically controlled.

This apparatus, while effective by itself, is supplemented by another member which takes account of another factor bearing upon the equilibrium, namely, the weight and inertia of the masses. Thus, for instance, if the aeroplane should start to plunge forward and downward, the increasing relative wind would force the aluminium plate to its rearmost limiting position, and the elevator would be set in its normal position; the aeroplane would then continue in its course, heading for the ground; it would require a special act on the part of the pilot to restore the machine to its normal position. This, then, would not be completely automatic working. To overcome this defect the inventor provides a pair of small weights *M* mounted upon the sliding rods of the aluminium plate *P*, and each maintained by two springs in such position that in normal flying the small weights follow the rods in all their movements. But as soon as the speed of the aeroplane changes, which will happen every time its course is deflected from the horizontal, these weights are either thrown forward or backward on account of the change of speed and their inertia. They thus overcome the tension of one or the other of the springs between which they are placed, and are displaced with reference to the rod upon which they rest. These weights are connected with the piston rod of the auxiliary motor, which thus receives from them the atmospheric impulses impinging upon the aluminium plate.

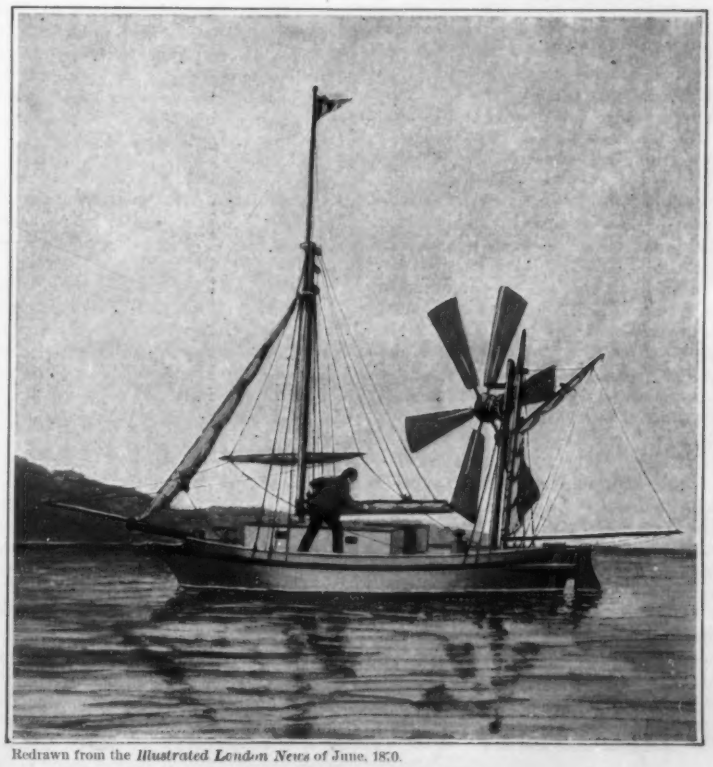
In consequence of this not only is the auxiliary motor (through the intervention of the aluminium plate and the motion of the small masses together) placed under the influence of the relative wind but also under the influence of the longitudinal pitching of the aeroplane, through the motion of the small masses alone. Accordingly, the elevator obeys automatically one or the other of these external influences, and the longitudinal equilibrium is restored.



Near view and detail drawing of the Doutre stabilizer.



General view showing arrangement of the Doutre stabilizer on the aeroplane.



Redrawn from the *Illustrated London News* of June, 1870.

An early transatlantic boat cruise.

An Early Transatlantic Boat Cruise

THE accompanying illustration, reproduced from an old volume of the *Illustrated London News* (June, 1870), presents a picture of quaint historic interest. The little boat, the "City of Ragusa," measured 20 feet in length and 6 feet in breadth of beam. Her registered burden was 1¾ tons. There was a small cabin, 3 feet wide and 4 feet 6 inches high. The boat, in its original form, belonged to the ship, "Breeze," which foundered in a storm in the Irish Channel, and fourteen of the crew were saved by the boat. As shown in our illustration, she is rigged as a yawl, arranged to set square sails on both masts, spreading altogether 70 yards of canvas in 8 or 9 sails. But she is also furnished with a two-bladed screw propeller which—so we read—can be worked either by hand or by a windmill, as shown in the illustration. We leave it to the reader to make his own comments on this "mechanism."

Two valiant men, Capt. Buckley and an Austrian-Italian, named Pietro Di Costa, planned to cross the Atlantic in this tiny craft. They left Cork Harbor on the evening of Thursday, and were last sighted by a pilot cutter forty miles west of Cape Clear. Of their subsequent fate our source tells us nothing.

Electric Lamps for Miners

THE following copy of the conditions of entry for a competition to be conducted by the British government for advertising a safe and efficient type of electric lamp for miners has been furnished by the United States Bureau of Mines, also by the British Ambassador in Washington.

His Britannic Majesty's government announces that, in order to encourage the production of safe and efficient types of electric lamps for miners, a colliery proprietor has placed at their disposal the sum of £1,000 ($4,866.65) to be offered as a prize for the best lamp or lamps fulfilling the requirements specified below.

Mr. Charles Rhodes (a former president of the Institute of Mining Engineers) and Mr. Charles H. Merz (a member of the departmental committee on the use of electricity in mines) have consented to act as judges. The conditions of the competition are as follows:

1. The competition will be open to persons of any nationality.

2. It will be in the discretion of the judges to award the whole of the prize for the lamp which they consider to be the

best, or to divide the prize, or to make no award if no lamp appears to them to be of sufficient merit.

3. Lamps must be addressed care of C. Rhodes, Esq., at the Home Office testing station, Rotherham, England, and must reach the testing station not later than December 31st, 1911. A spare globe should accompany each lamp.

The requirements which should be fulfilled by any lamps submitted for competition are as follows:

1. The lamp should be of sound mechanical construction, so as to withstand rough usage.

2. The lamp should be of simple construction and easy to maintain in good order and repair.

3. The lamp should be so constructed as to render impossible the ignition of inflammable gas either within or without the lamp.

4. The lamp battery should be so constructed that any liquid which it may contain cannot be spilled when the lamp is in use, and means should be provided for dealing with any gas which may be generated by the battery.

5. The materials used and the construction should be such that metals and other parts will not be liable to deterioration by corrosion as a result of the action of the "electrolyte," etc., used in the battery.

6. The lamp should be effectively locked so that it cannot be opened without detection.

7. The lamp should be capable of giving an amount of light not less than 2 candle-power continuously for a period of not less than 10 hours.

8. The light should be well distributed outside the lamp. A movable reflector to concentrate or to shield the light may be provided.

In addition to the above requirements, regard will be paid to (*a*) the first cost of the lamp; (*b*) the cost of maintenance; (*c*) convenience in handling, and (*d* the) weight of the lamp when charged and ready for use.

Trade-mark Rules Amended

ACTING Secretary of the Interior Samuel Adams recently approved the recommendation of the Commissioner of Patents that certain amendments to the Trade-mark Rules be adopted to take effect November 1st, 1911.

The amendments are as follows:

To be inserted immediately following Rule 45:

45a. If an applicant fail to prosecute his application within one year prior to November 1st, 1911, or for one year after the date when the last official notice of any action by the office was mailed to him, the application will be held to be abandoned as set forth in Rule 57a.

45b. Whenever action upon an application is suspended upon request of an applicant and whenever an applicant has been called upon to put his application in condition for interference, the period of one year running against such application shall be considered as beginning at the date of the last official action preceding such actions.

45c. Acknowledgment of the filing of an application is an official action. Suspensions will only be granted for good and sufficient cause and for a reasonable time specified.

45d. Only one suspension must be approved by the Examiner of Trade-marks. Any further suspension must be approved by the Commissioner.

The first paragraph of Rule 56 is cancelled. This paragraph is as follows:

56. From an adverse decision of the examiner in charge of trade-marks upon an applicant's right to register a trade-mark, or to renew the registration of a trade-mark, or from a decision of the examiner in charge of interferences, an appeal may be taken to the Commissioner in person, upon payment of the fee required by law.

For the above there is substituted the following:

56. Every applicant whose mark has been twice refused registration by the Examiner of Trade-marks for the same reasons upon grounds involving the merits of the application, may appeal to the Commissioner in person upon payment of the fee required by law. Such refusal may be considered by the Examiner of Trade-marks as final.

There must have been two refusals to register the mark as originally filed, or, if amended in matter of substance, the amended mark, and, except in cases of division, all preliminary and intermediate questions relating to matters not affecting the merits of the application must have been settled before the case can be appealed to the Commissioner.

The remaining paragraph of Rule 56 stands unchanged.

Following Rule 57, which relates to the taking of appeals in trade-mark cases to the Court of Appeals of the District of Columbia, there is inserted the following:

57a. An abandoned trade-mark application is one which has not been prosecuted within one year prior to November 1st, 1911, or completed and prepared for examination within one year after the filing of the petition, or which the applicant has failed to prosecute within one year after any action therein of which notice has been duly given, or which the applicant has expressly abandoned by filing in the office a written declaration of abandonment, signed by himself and assignee, if any, identifying his application by serial number and date of filing.

57b. Prosecution of an application to save it from abandonment must include such proper action as the condition of the case may require. The admission of an amendment not responsive to the last official action, or refusal to admit the same, and any proceedings relative thereto, shall not operate to save the application from abandonment.

57c. Before an application abandoned by failure to complete or prosecute can be revived as a pending application it must be shown to the satisfaction of the Commissioner that the delay in the prosecution of the same was unavoidable.

57d. When a new application is filed in place of an abandoned or rejected application, a new petition, statement, declaration, drawing and fee will be required.

The foregoing amendments to the rules of the Patent Office relating to the registration of trade-marks, for the most part, are a paraphrase of similar rules that have long been adopted and used in connection with the prosecution of applications for patents. Thus, 47a corresponds with Rule 77 of the Rules of Practice; 56 corresponds with Rules 133-134; 57a corresponds with Rule 171; 57b with Rule 171; 57c with Rule 172, and 57d with Rule 173, etc.

At the present time the practice in the Division of Trade-marks is and has been not to consider an application abandoned by reason of the failure of an applicant to prosecute it within a specified time. There is every reason why this practice should not continue. Under the present practice, the first application filed under the Act of February 20th, 1905, which was acted upon soon after, must be taken up for action whenever the applicant desires, even if no action has been taken by applicant in the intervening time. As the result of this procedure and the accumulation of a large number of cases, the Trade-mark Division is seriously handicapped in the prosecution of its necessary business. It is estimated that there are now on file about sixteen thousand cases not "awaiting action" by the Office, and that three-fourths of these cases filed prior to January 1st, 1909, have not been acted upon within one year.

Under the rules as amended to take effect November 1st, 1911, it is believed that the present difficulties involved in making an issue search would be materially lessened. This search is made once a week by each of the seven assistant examiners and necessitates examining every one of the sixteen thousand drawings. This has become a severe burden and was rapidly becoming more so. It is estimated that at the end of ten years there will probably be twenty thousand more drawings which, added to those that are already filed, would make thirty-six thousand drawings. To search these once a week is an appalling task. When it is also considered that the search of the examiners is increasing in length each year, due to the increase in the number of registrations granted, it is easy to see that the system in vogue could not indefinitely continue. It was desired, therefore, to confine, so far as possible, the energies of the examiners to the search proper rather than expending them uselessly in searching each week a large number of practically dead applications. This saving in time and labor on the part of the examiners will greatly facilitate better and more expeditious examinations.

The rules as amended seek to accomplish only, in connection with trade-mark applications what is now accomplished in connection with applications for patents by similar rules. The language of the rules follow somewhat closely the corresponding rules, so far as the language employed in connection with applications for patents is deemed applicable to applications for the registration of trade-marks. Moreover these rules are regarded as being in every way consistent with the statutes.

Notes for Inventors

Losing One's Way in the Air.—An army aviator, Capt. Paul Beck, flying from College Park, Md., recently lost his way for an hour or so in the clouds and landed finally over in Montgomery County, miles out of his course. It appears that the ordinary mariner's compass is not satisfactory for use in the air, since the aviator cannot determine, after he loses sight of the earth, the extent to which he may have drifted laterally from his course. The incident has stimulated renewed interest in the subject and Capt. Chambers, who has charge of naval aeronautics, is continuing his efforts to devise some means whereby aeronauts may be able to determine the course with reasonable accuracy.

A Medal for a Printing Office Employee.—On behalf of the Public Printer, Vice-President Sherman has presented the assistant foreman of the foundry section of the Government printing office at Washington, D. C., with a gold medal for an invention, hygienic in its nature, and operating to reduce the danger to health, resulting from graphite dust in electrotyping and printing.

A Domestic Cream Separator.—A domestic cream separator embodied in a milk bottle of the form commonly used by dairymen in delivering milk to customers is shown in a patent, No. 999,747, to Ada B. Brown of Seattle, Wash. It has an L-shaped tube journaled in an opening in its side at about the base of the neck and having an upturned wing in the bottle which, by turning the horizontal journaled wing, can be set to different heights to take cream from different levels and discharge it through the horizontal wing to the outside of the bottle.

A Fireproof Coil for Electrical Apparatus.—Seeking to provide a fireproof coil for electrical apparatus, Charles E. Skinner of Wilkinsburg, Pa., assignor to the Westinghouse Electric & Manufacturing Company, has patented No. 999,893, a coil which has a plurality of turns of conducting material with a strip or layer of metal foil interposed between the adjacent turns, the foil being first treated to provide an insulating film on its surface.

A Moving Spiral Staircase.—The Otis Elevator Company has obtained a patent, No. 999,885, for an elevator which has a conveyer transporting between different levels in which the direction of movement is clockwise and contra-clockwise. The elevator is in the form of a moving stairway, having ascending and descending series of steps which travel in spiral paths in opposite directions about a common center of curvature. The inventor is Charles Leeberger of New York city.

Printing by Sound.—A method of printing by sound is the subject of a patent, No. 999,975, to Arthur C. Ferguson of Brooklyn, assignor of eleven-sixteenths to Lyman C. Smith of Syracuse, N. Y. By the method, the sound waves are recorded by utilizing a succession of said waves to initiate the operation of mechanism actuated by a separate source of energy for printing a legible character corresponding to certain tone characteristics of said waves. In other words, the character printing mechanism is actuated by a separate source of energy and the waves are utilized to control such source of energy.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

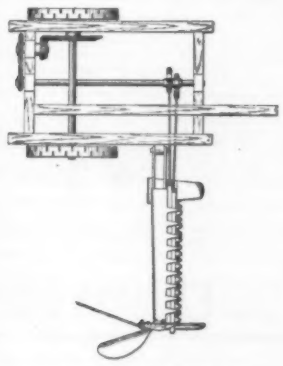
Electrical Devices.

HIGH TENSION STRAIN INSULATOR.—L. STEINBERGER, New York, N. Y. This insulator is for general use where currents of high potential are employed, it being especially well adapted for use in wireless telegraphy and telephony. Mr. Steinberger's special purpose is to provide a number of novel constructional features in order to improve the general efficiency of the insulator, and to enable him to make it of an insulating material formed under pressure or molded, or of porcelain, glass or such like material, and to employ tension members of a rigid or of a flexible character, as may be desired.

ELECTROMAGNETIC VIBRATOR FOR LOCAL APPLICATION TO THE PERSON.—A. ROSENBERG, London, England. This vibrator is for use for the production and local application to the person, of continuous, rapid, and intense mechanical vibrations of oscillations suited to the treatment of various maladies which are capable of being temporarily or permanently ameliorated by the application thereto of the mechanical vibratory massage and to the combination with the instrument of means whereby a pulsatory electric current may be passed through the body from the point of application thereto of the vibratory treatment and simultaneously with the latter.

Of Interest to Farmers.

CUTTING MACHINE.—CLARENCE SHAW, Johnstonville P. O., Lassen Co., Cal. This invention relates more particularly to cutters and swathers for cutting grain and the like, and the object is to provide a device for cutting down grain and the like when it is desired to harvest the same. For the purpose mentioned, use is made of a vehicle chassis provided with a cutter frame having a plurality of cutter bars thereon and connected with



CUTTING MACHINE.

eccentric means, secured to suitable driving means in engagement with the wheels of the vehicle, to operate the cutter bars, and a swather secured to one end of the frame for dividing the cut and uncut grain and for substantially preventing any grain passing through the cutter bars after the same has been cut down. The engraving shows a plan view of the machine.

Of General Interest.

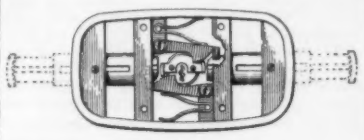
JOINT FOR ARBORS.—H. S. DAVIS and J. C. HAYDEN, P. O. Box 342, Port Hope, Ontario, Canada. In this case the purpose is to provide joints for arbor sections used in castings which will permit the sections to be readily separated by striking one of the ends of the arbor and breaking the wedge member holding the sections together. Another object is to so construct the sections that they will be held together by a wedge member of combustible or fusible material, the rigidity of which is lost by the heat and by contact with the metal, thereby permitting the sections to fall apart as the casting is removed from the same.

BASE FOR CARDBOARD FIGURES.—R. G. FRASER, Philadelphia, Pa. The invention refers particularly to miniature cardboard figures in the shape of dolls and the like, and the object is to provide a form of base for holding the cardboard figure. Wood and metal are ordinarily employed for the purpose; aside from the expense, they leave much to be desired in applying the base to the figure and the secure holding of it in place, while the present base permits of employing a figure made from much lighter cardboard than is really practical with a wooden or metallic base.

Hardware and Tools.

COMBINED LOCK AND RETAINING DEVICE.—M. JADRONJA, New York, N. Y. In this instance use is made of a bolt slidably mounted in the inner end of a receptacle to engage the casing thereof, actuating means mounted on the outer end of the receptacle, and a flexible connection disposed between the actuating means and the bolt so that the bolt will releasably engage the casing when the actuating means are operated and the bolt being normally positioned so that the receptacle cannot be entirely withdrawn from the casing.

LOCK.—RAFFAELE FEOLA, 2 East 120th Street, New York, N. Y. A rear elevation of this lock is reproduced in the illustration, which shows the bolts projected in dotted outline. The lock serves the purposes of the ordinary padlock, which, when in position prevents the staples or eye-bolts from being cut or filed, and which renders difficult other unauthorized

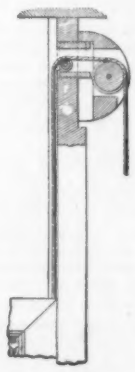


LOCK.

methods of opening the lock. The bolt proper is operated by key-controllable mechanism of the pin-tumbler type, which permits of a large number of variations in the key-controllable mechanism, and which may have the casing of difficult shapes adapted for use with different kinds of doors or other closures.

Household Utilities.

SASH CORD GUIDE.—JAMES P. O'REILLY, Hayden, Ariz. By the old construction and method of attachment, it is necessary to bore two holes one-eighth of an inch deep in the window jamb and then three more completely through the frame, and finally to chisel out the triple bore to form a mortise adapted to receive the pulley frame. In carrying out

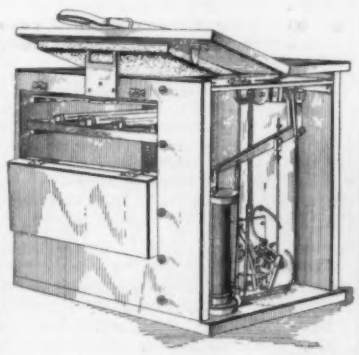


SASH CORD GUIDE.

the present invention it is required to bore only one hole and through the jamb, and then to insert therein a hollow cylinder having, interiorly, a small sash-cord pulley, and on the projecting end of the cylinder the frame containing the usual sash-cord pulley is hung detachably, the engagement being effected by a sliding joint. The engraving is a vertical section of window frame or joint, with the attachment applied thereto.

Machines and Mechanical Devices.

AUTOMATIC PHOTOGRAPHIC PRINTING MACHINE.—GEORGE W. FERGUSON, 314 Booneville Street, Springfield, Mo. The present device is an improvement over that disclosed in the prior patent No. 957,665 granted to Mr. Ferguson. The aim of the present invention is to provide devices for timing the exposure. These include novel means for switching on and off the circuits, and for controlling the same. A further object is to provide a remov-



AUTOMATIC PHOTOGRAPHIC PRINTING MACHINE.

able lamp holder which may be quickly removed from the device so as to replace the lamps in case they become broken, and as quickly replaced, the replacement of the holder serving to again bring the lamps into circuit. The illustration herewith represents the main box, the end being removed for the sake of clearness.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12526) C. H. K. asks: 1. It is held I think by most astronomers that the pole of the heavens traces a complete circle around the pole of the ecliptic in about 25,000 years, and has for its center the pole of the ecliptic. There is also a decrease in the obliquity of the ecliptic of about 45 seconds in a century. Now, how can the pole of the ecliptic be the center of the circle traced by the pole of the heavens when the distance is gradually decreasing between them? As the obliquity of the ecliptic is equal to the radius of this circle, we would then have a circle in which the radius is constantly changing, which is I think quite impossible. A. In an exact sense it is true that a curve with a radius which varies cannot be a circle, as you say; but since the obliquity of the ecliptic changes by only a few seconds in 100 years, while the precession of the equinoxes is about 50¼ seconds in one year, the change in the radius of the precessional effect on the pole of the heavens is almost infinitesimal in one year. We think astronomers are quite warranted in speaking of the motion of the pole of the heavens as in a circle around the pole of the ecliptic, although some use the better term "cycle," since the variation in the obliquity of the ecliptic is also in a cycle. At some remote time it will return to its present value. 2. What was the obliquity of the ecliptic in 1900? A. The obliquity of the ecliptic for 1900 was 23 deg. 27 min. 8.02 sec., as given in Todd's "New Astronomy," page 150, a book which we send for $1.50. 3. Is there any evidence to show that an individual organism has the power to modify itself physically to meet a change in environment, or meet conditions to which it is not adapted? A. Probably an individual organism has not the power to modify itself radically to meet a sudden change of environment to which it is not adapted. 4. Is there anything to show that evolution takes place apart from natural selection? A. All the causes of change in species and individuals, and not natural selection alone, are involved in the proof of the theory of evolution. The literature of the subject is very extensive, beginning from Darwin's "Origin of Species," which we will send for $2. Many articles have from time to time been printed in our SUPPLEMENT.

(12527) R. A. S. asks: What is the astronomical name of the star which is known as the star of Bethlehem, which guided the shepherds and the wise men at the birth of Jesus Christ and can be seen in Palestine every year on and about December 25th? A. There is no star known to astronomers as the "Star of Bethlehem." 2. Would a postage stamp vending machine pay? In the large post offices a great deal of time and bother is taken in handling and selling postage stamps. Would it not pay the Government to have machines in the large cities eliminating this trouble? A. There are several kinds of stamp vending machines in use in many cities, both in America and Europe. We do not know whether they are profitable or not. 3. What are the advantages of raising the "Maine"? Does it not cost more to raise it than the old hull is worth? A. The raising of the "Maine" clears a dangerous obstruction from a friendly harbor, enables us to give burial to the bodies of the men who died in the service of their country on this ship, and may clear up the uncertainty as to the cause of the explosion. Any one of these reasons is quite sufficient to justify the expense of the work. The old hull is worthless. It was long ago corroded by salt water, and was so twisted by the explosion that it could not be rebuilt to be of any value. Its only pecuniary value would be as old metal.

(12528) J. C. O. says: Regarding a differential gear on an automobile using say 40 horse-power, A claims that in traveling in a straight line the same amount of power is applied to both drive wheels, but that in turning a corner the power is shifted to the outside drive wheel, and that if it were required practically the full (40) horse-power would be exerted on this outside driver. B claims that in making the turn as much power is exerted on the inside driver as on the outside; in other words (if it were required) 20 horse-power on each driver. Which is correct? A. The driving gear of automobiles is designed to exert an equal turning movement on each driven wheel at all times. If an automobile could be steered so sharply to one side that one rear wheel stood still while the other turned around it in a circle (this might be done by a three-wheeled car) the stationary wheel would be pulled on by the gearing just as hard as the moving wheel; but as it could not turn no "work" would be done upon it, and the "work" of turning the car would be done by the moving wheel entirely. Do not confound *force* with *work*; the latter implies motion in the direction of the force which produces it.

NEW BOOKS, ETC.

THE PRINCIPLES OF INDUSTRIAL MANAGEMENT. By John C. Duncan. New York; Appleton & Co., 1911. 323 pp. Price, $2.

The book is divided into three main sections devoted respectively to "The Economic Environment," "The Equipment of the Plant," and "Organization and Management." It deals on broad lines, and yet in considerable detail, with the various factors upon which the economic success of an industrial enterprise depends. The theory of industrial location, the different forms of "business concentration and integration," and the *rationale* of business specialization are some of the topics discussed in the first part of the book. The first three chapters of the second part follow a classification of the various industries as "synthetical," "analytical" and "assembling industries," a number of specific examples of each kind being discussed as regards questions relating to plant equipment. Other topics taken up in this portion of the book are "Fire Precaution"; "The Building," especially in its relation to the workers; and "The Power Problem." The last section discusses the different types of organizations, the labor force, and the methods of keeping records of work, equipment, raw materials, etc., and controlling expenditures in wages and purchases accordingly. The subject with which Prof. Duncan deals is one of the greatest practical interest, and will appeal to all who take any share in industrial work.

MOEURS DES INSECTES. By J. H. Fabre. Paris: Delagrave, 1910. 271 pp.; 12mo.

This volume is a selection of essays from the author's "Souvenirs Entomologiques." These delightfully written essays in a popular vein have been widely circulated in France, as they justly deserve to be. They are literature of a most artistic kind, even though the subject is scientific.

SKETCH OF A COURSE OF CHEMICAL PHILOSOPHY. By S. Cannizzaro (1858). Alembic Club Reprints. University of Chicago Press, 1911. Price, 43 cents.

To the person who has once acquired the habit of viewing the main facts of modern science in close relation to their historic development, this standpoint acquires a special value which is more easily appreciated than explained. The growth of a science is itself a natural phenomenon of peculiar interest, and probably no one ever made himself the master of any branch of science, who did not in the process acquire a fairly complete knowledge of the genesis and history of that science. The consultation of first hand sources, as compared with the mere reading of textbook reproductions, has, upon the student, an influence somewhat akin to that which personal contact with the great workers in science exerts. These things can be felt, but are difficult to analyze and explain. That they have been keenly felt by some of the foremost men of science is the cause of the publication of such series of reprints of classical scientific papers as the Alembic Club Reprints in English, and Ostwald's Klassiker in German. To express commendation of such publications, in view of the great authorities who have not merely passively approved of them, but actively assisted in their realization, would seem almost presumptuous, and is at any rate quite unnecessary. That the present little volume should form one of such a series is particularly fitting. In it Cannizzaro presents with the masterly method of a great teacher the fundamental facts which form the basis of Avogadro's hypothesis. It must be remembered that, while this hypothesis had been put forward as early as 1811, more than forty years prior to the date of Cannizzaro's work here republished, very little notice had been taken of Avogadro's law, and its immense importance to chemistry was not realized. Without this hypothesis a rational system of atomic weights was impossible, chemical notation was in a bewildering state, and the proper interpretation of all those relations between elements, which are closely connected with their atomic weights, was rendered extremely difficult. It is hardly possible to overestimate the importance to the chemical world of Cannizzaro's influence in bringing about the general appreciation of Avogadro's hypothesis. The little book should be in the library of every teacher of chemistry.

THE PRINCIPLES OF MACHINE WORK. By Robert H. Smith. Boston: Industrial Education Book Company. 8vo.; 388 pp.; 434 illustrations. Price, $3.

This textbook, which takes up the subject where "The Elements of Machine Work" dropped it, admits technical students into the secrets of engine and speed lathes, drilling and grinding machines, steel cutting, measuring, turning, fitting, threading, chucking, reaming, jigs, fixtures, and cylindrical grinding. Mechanisms, tools and their approved methods of use are shown in original perspective and mechanical drawings while condensed tables briefly describe them. The common machining operations, with typical problems, are given in schedules which name the material, processes, machines, speeds, feeds, jigs, fixtures, and tools. As a guide to the young student or shop apprentice the work should prove invaluable.

The Heavens in September

(Concluded from page 208.)

when she rises a little earlier than Mercury. On the 24th the two planets are in conjunction; that is they are as close to one another as their apparent paths allow; but in this case their distance is unusually large—over nine degrees—Mercury being the farthest north.

Mars is in Taurus, between the Pleiades and Aldebaran in the middle of the month, and rises about 9:30 P. M. Though only about half as bright as he will be at opposition in November he is already a very conspicuous object.

Jupiter is evening star in Virgo, and sets a little after 8 P. M. on the 15th. Saturn is in Aries, approaching opposition and rises at about 8:45 P. M. on the same date.

Uranus is in Sagittarius and comes to the meridian at 9:10 P. M. on the 1st and 7:16 on the 30th. Neptune is morning star in Gemini, rising about 1 A. M. in the middle of the month. The Moon is full at 11 A. M. on the 8th, in the last quarter at 1 P. M. on the 15th, new at 9 A. M. on the 22d, and in her first quarter at 6 A. M. on the 30th. She is nearest us on the 17th, and farthest away on the 1st, and again on the 29th.

She is in conjunction with Uranus on the 4th, Saturn on the 13th, Mars on the 14th, Neptune on the 17th, Mercury and Venus on the morning of the 21st, and Jupiter on the night of the 25th.

At 11 A. M. on September 23rd the sun crosses the celestial equator, entering the sign of Libra, and, in the old phrase, still used in almanacs, "autumn commences."

How Animals are Taught Their Tricks

THE training of animals, to teach them to perform all sorts of entertaining tricks, is a task that requires perhaps a special talent on the part of the trainer, but above all demands patience and a thoroughly methodical procedure. Let us begin with the dog, and see how he is taught his tricks. We commence with the simplest, and gradually work up to the most complex and apparently impossible feats.

The first thing every dog must learn is his name. Select a short, sharp-sounding name, and stick to it. Never call him anything else. If you have several dogs, the name is taught on the same principle. Divide their food, and then, placing a piece on the ground, call each in turn by his name, and give him the food when he comes for it. Send the others back if they come forward out of their turn. By and by they will learn that a certain name is always associated with a certain dog. Ramble among the dogs, and call out one of their names every now and then. If the right dog comes to you, reward him with a piece of cracker. Pay no attention to the other dogs. They will learn very soon; and the first great lesson—dependence and obedience—will have been learned.

Having taught a dog to fetch and carry—which he will easily learn—the next thing is to teach him to go and get any object called for. Place a glove on the floor; then say to the dog, "Fetch the glove," putting the accent on the last word. Then, when he has done this several times, place a shoe on the floor; and teach him to fetch this in a similar manner. Now place both objects on the ground, and teach him to fetch either one, as asked for—rewarding him when he brings you the right one, and rebuking him when he fetches the wrong, which you take from him and replace. He will soon learn to distinguish the articles, when a third may be substituted, and so on until a number are on the floor. You should then go into the next room, taking the dog with you; and send him in to fetch any article you mention. After a little time, he will bring you the right one every time.

Next, teach him differences in color. Place a red object on the floor, and a blue one beside it. Teach him to fetch you the article called for as you did before, being careful to reward him every time he brings you the right handkerchief. Then put down a green object, a purple, a yellow one, and so on; until finally the needed array of colors can be placed for selection.

Next, he should be taught the articles of furniture—table, chair, etc. He must go to each one as you call out its name. Finally, combine some of the previous commands: "Place the glove on the chair"; "Get the handkerchief, and place it on the table," etc. At first this should be said very slowly, and only half the command repeated at once; but the halves of the sentence may be gradually blended together, until you can say it as you would to any individual; and the dog will obey your command.

To a certain extent, also, dogs may be taught the letters of the alphabet, the numbers of spots on cards, large dominoes, etc. The method of training them is simply one of constant repetition. Cards bearing the letter or number are placed in front of the dog, and the letter or number is called out aloud, and at the same time the dog is shown which one it is. After several trials, he will select this one and disregard the others, when it is called for. This once learned, the next letter is taught in like manner, until a large number are recognized by the dog, and he is able to pick out any of them at will. Plants are also to be selected in a similar manner, from a row placed on the table, and so forth.

It must be admitted, however, that most feats of this character, as performed in public, are the result of some trick, rather than any marvelously elaborate training on the part of the dog, which would be necessary if these feats were genuine—granting them to be possible at all. As a matter of fact, most of these apparently marvelous feats are based on a very few cues, given to the dog at the appropriate time, to which he has been taught to respond in a simple manner. A few examples will make this clear.

Many of these feats are performed by means of a cue word, in just the same kind of way as "mind-readers" entertain and puzzle their audience. As soon as this word is given, it may be in the course of a sentence, the dog knows that he is to perform a certain action. It is not necessary for him to understand the whole of the sentence; only one word in it. As soon as that word is caught, the action is performed. Each action corresponds to a certain cue word. Again, there is the method of training by the use of the eyes. The dog watches his master's eyes, and when his master glances in any direction—at a card, for example—the dog can follow his glance, and pick out the card in turn. Or the dog may be told to bark a certain number, in which case the dog watches his master's face closely, and simply barks until the eyes, or some movement, tell him to stop. He does not have to know that he barks nine times. All he has to know is that he must go on barking until he is told to stop by his master's signal; and the trainer is the one who does all the counting.

There are certain stage tricks which depend very largely upon the dog's memory, however—such as picking up a numbered card, and the like. The cards are arranged in a row, and the trainer stands in front of the row in which the card rests. A string is attached to the dog's neck. First, the dog is trained to go to the row of cards nearest the trainer; then, if he is inclined to pick up one too near, a slight pull on the string is given, pulling the dog up to the required number. The trainer stands at a certain distance from the table in these tricks; if close to the table, the dog knows it means card one; if farther away, card two, and if still further, card three. By care in training, the dog can be taught to pick out any required card, without in any way knowing the number written upon it. When the dog has been taught to pick up any card by means of this code, the trainer may appear to make it far more complicated by causing the dog to add, subtract, multiply, divide, etc. All that is necessary, of course, is that the performer himself should do the sum, mentally note the position of the card giving the answer, and indicate this card to the dog by means of some hidden code.

In the same way, horses can be made to stamp out any desired number, tell the date of a coin, etc., by simply going on pawing the ground until the trainer gives them the signal to stop by means of some secret sign, unnoticed by the audience.

As to the animals which perform in the circus, the elephant is among the most popular, and it seems wonderful that so unwieldy an animal can be made to perform any tricks at all. How set about training an animal of this kind? What is the first thing to be done? And how?

In compelling the elephant to perform, advantage is taken of the fact that the feet of the animal are peculiarly sensitive and he dreads any injury to them. Many of his tricks are based upon this principle. Thus, he is made to place one foot upon a low pedestal; then the other foot is tapped gently, and he raises this and places it beside the other—to get it out of harm's way. The hind feet are treated similarly, in turn—the front feet being hit every time they are placed on the ground. In this way all four feet are finally placed upon the tub. The trick of inducing an elephant to partake of a meal is very simple. Animals will naturally eat anything placed before them, and it is only necessary to open a bottle of "pop" once or twice, and present it by hand, when the animal may be trusted to find out for himself how to get at its contents. In all such cases, the essence of the training consists in infinite patience, kindness, and constant repetition—showing the animal over and over again how a thing is done—in precisely the same way—and then forcing him to do it himself.

Lions and tigers are always dangerous creatures to work with, and one can never be sure of them, even when trained. "No wild animal," says Mr. Bostock, "is ever tamed, only trained, and the best training in the world is nothing when once the animal feels inclined to give way to his natural savage instincts."

"In time," continues Mr. Bostock, "the trained animal becomes so accustomed to performing that when he sees the paraphernalia of his performance he knows exactly what is expected of him, and does it naturally and readily. The successful performance of all trained animals depends on this almost instinctive following of long-accustomed habit, together with the pleasure the exercise gives to animals habitually confined in small cages. . . .

"Leopards, panthers, and jaguars are all trained in much the same manner. Mme. Morelli puts them through a course of training very similar to that given the lion. They are taught to respect and look for the trainer, and have instilled into them as much awe as is ever bred in any animal—which is not saying a great deal. . . . . Some animals train easily; others learn their lessons with great diffidence and some reluctance. What one lion may learn in a week another may learn in a month; what one tiger may do in two lessons may take another one several months to imitate feebly."

Goats are very sure-footed animals, and learn to perform many tricks requiring that quality—such as standing on the end of a bamboo pole. The Hindus teach goats to do this. Hogs may be taught a number of clever tricks, and are far more intelligent than is generally imagined. Monkeys are known to be capable of being trained to a remarkable degree, the feats of "Peter" and "Consul" being well known to the American public. They are good imitators, and excessively curious, and it is this faculty, and their ingenuity in satisfying this curiosity, which has amused many an audience; and has given rise to the popular notion that monkeys are far more intelligent than they really are. As a matter of fact, although a few of them are highly trained and intelligent, this is not the general rule.

A few birds may be trained to perform simple tricks, but not many. "Fortune tellers" employ tame birds to help them in their trade. A number of small paper envelopes are seen, in a row, one of which contains your "fortune" in the shape of a slip of paper, telling you certain platitudes about yourself. The bird picks this envelope out with his bill, from among others. How is it he selects this particular one? Some of the envelopes have seeds glued to their back-covers, and the bird naturally picks out one which has the seed thus attached—passing over the others to get to it. In most birds, when first caught, a portion of the inner plume of the pen-feathers is cut, so that the bird cannot escape; and then the nostrils of the bird are touched with bergamot or other odorous oil, by which it is for the time so stupefied that it perches quietly on the finger. It is then taught to hop from one finger to another. In this way its training is begun.

Snakes are trained by the natives of India, and no other nation has succeeded in reaching so high a degree of efficiency as these East Indians. The fangs of the snake are first extracted, so as to render it harmless; it is fed on milk, and more or less drugged a good part of the time—as are many other animals which perform in public. The peculiar character of the native music seems to hypnotize the creatures, which, under its influence, emerge from their baskets and are handled with seeming impunity by the natives.

Seals are very intelligent animals—despite their looks—and may be taught a number of tricks of an intricate character—tricks requiring a delicate sense of balance and manipulation. Kangaroos also may be taught to box and wrestle with their trainers, and in many ways make excellent performers.

The Current Supplement

A SERIAL article from the authoritative pen of Prof. H. H. Turner, of Oxford, England, begins in the current issue, No. 1861, of our SUPPLEMENT. The eminent astronomer gives a most interesting account of the history and function of the Great Star Map, in the preparation of which workers all over our globe are taking part.—This issue also brings the sixth instalment of Donald Murray's article on Printing Telegraphy.—Major Bartlett continues his most interesting discussion of "Logistics," and the problems that arise in taking care of the bodily needs of an army in the field.—In an article on "The Dawn of Architecture" Mr. John L. Cowan brings before us a vivid picture of the first steps in the evolution of human dwellings.—A very remarkable and extremely delicate new test for adulteration of oils with mineral or resin oils is described by A. E. Outerbridge, Jr.—Much has been said and written in late years of the gyroscope and its intentional application to various purposes. That gyroscopic effects appear as uninvited guests in machinery is a fact which has to be reckoned with on aeroplanes for example. This subject is lucidly presented by Mr. A. Kapteyn.—A number of clever "Household Inventions" are reproduced from *La Nature*.—Mr. E. L. Thorndyke suggests an ingenious method of quantitative measurement for the quality of literary style, which he applies primarily to the performances of school children.—The mind stands aghast before the figures which must be used to represent the dimensions of some of the objects which the modern physicist measures with comparative ease and certainty. Not so very long ago it was thought a remarkable achievement of the human mind when a numerical estimate of molecular dimensions was gained. Now we have the electron, whose mass is about one eighteen-hundredth of that of a hydrogen atom. Prof. Pyle of Washington University gives a vivid account of these modern developments.

The German Artificial Sponge

AN artificial sponge, the outcome of German ingenuity, is now to be had. The process of making it consists principally in the action of zinc chloride on pure cellulose. This results in a pasty, viscous mass, which is mixed with coarsely grained rock-salt.

Placed in a press-mold armed with pins, the mass is pierced through and through until it appears traversed by a multitude of tiny canals, like the pores of a natural sponge. The excess of salts is subsequently removed by prolonged washing in a weak alcoholic solution. The artificial sponge swells up with water, but hardens on drying, just like its prototype; it is said to be eminently adapted for filtering water for sanitary or industrial uses, and it can be employed for all the purposes that are usually assigned to the genuine article.

Electricity

Some Recent Developments in Railway Telephony.—The telephone has been found to possess advantages over the telegraph on railroads, and it is stated that on about 37,000 miles of road the former has now been adopted without any accident having been attributed to its use. This change has been made within the last four years. The three main classes of service performed by the telephone are (1) train despatching, (2) message service, and (3) block-wire service.

Mercury Contact for Railroad Signals.—A novel contact for railway signals has recently been designed, which obviates the necessity of energizing the rails themselves in order that the circuit may be closed by the trucks of the passing trains. The device consists of a treadle secured to the under side of a rail between the points of support. As the rail is flexed under the weight of a passing load, it presses a plunger downward against a diaphragm covering a chamber filled with mercury. Owing to the area of the diaphragm, a very slight depression causes considerable rise in the column of mercury at one side of the chamber. The mercury thus closes the circuit of the electric signal.

Novel Fan for Dining Tables.—It is always difficult to break away from old ideas. The disk type of electric fan has shown no marked change in design since the day it was first introduced. It still throws a stream of air in a single direction and in order to distribute the cooling effect of the fan to better advantage, various schemes have been devised such as turning the fan bodily or shifting direction vanes before it. An entirely new scheme has now been evolved in which the fan is radically altered. This fan throws a centrifugal zone of air. It is mounted on a vertical shaft and its blades are also vertical, giving it a cylindrical form. As this revolves, it sucks in air from the top and bottom and throws it out centrifugally. A fan such as this placed at the center of a dining table serves to cool all the diners uniformly.

Double Antennae for Determining the Direction of a Transmitting Wireless Station.—If two identical antennae are placed a small distance apart as compared with their common distance from a transmitting station, they perform identical oscillations, so far as amplitude of current and voltage is concerned, but the current and voltage are displaced with regard to each other by a phase difference depending on the distance between the two antennae and the angle which the line joining the same makes with the direction of propagation of the waves. An arrangement consisting of two antennae and two phase meters can therefore be used to ascertain the direction from which the oncoming wave is being received. An installation of this kind has been described by Mr. Petit in *La Lumière Electrique*, as is noted in a recent number of the *Génie Civil*.

Aluminium Coils in Traction Motors.—Considerable interest was shown at the International Congress at Brussels, in a paper on the subject of using aluminium in place of copper for the field coils of street railway motors. A number of cases were referred to in which such coils had been in use for several months. In some instances the wire was insulated with rubber, in others with lacquer, while in still others bare aluminium wire was used, the aluminium oxide serving as sufficient insulation between turns, while paper, cloth and the like, were used between layers. The advantages claimed for aluminium, are that it saves 50 per cent in weight for the same resistance, and, in view of the fact that there is a larger volume of aluminium in a pound than of copper, there is a saving of about 60 per cent in the cost of the material. Another thing to be considered is the fact that aluminium coils are much lighter, and hence make a smaller load for the motors to carry, and are less affected by vibration and shock. Furthermore increase in temperature is less destructive because less or no insulation is used. To offset these advantages aluminium coils must have a larger cross-sectional area, and the metal is exceedingly difficult to solder.

Science

Prof. Kossel in the United States.—Prof. Albrecht Kossel, of the University of Heidelberg, arrived recently in this country for the purpose of delivering a series of lectures at Johns Hopkins, and other American universities. Prof. Kossel was awarded the Nobel prize in 1910 for his researches in medical chemistry.

Wireless Weather Reports from Gibraltar.—We learn from *La Nature* that wireless weather reports are now sent every morning from Gibraltar to the Meteorological office in London. The dispatch is copied, en route, at the Tour Eiffel in Paris and promptly sent to the headquarters of the French meteorological service, which includes it in the daily weather bulletin. The use of wireless telegraphy in meteorology is rapidly growing, despite the discouragements that attended the earlier attempts in this direction, and is clearly destined to greatly facilitate the methods of weather forecasting.

Cleaning Cleopatra's Needle.—The Egyptian obelisk which is known as Cleopatra's Needle, which stands on the Thames Embankment, is being cleaned for the first time in its history. For centuries it stood in its native land and never needed the brush. London soot and fumes have begun to mar the face of the obelisk. The obelisk in New York has been protected for years by means of paraffin, in accordance with a method devised by the late Prof. R. Ogden Doremus. London seems to be baffled by the same problem. There seems to be no reason why the Doremus method would not apply.

Loess.—The formation of "loess," a fine yellowish sandy clay found in various parts of the world, and reaching a thickness of over a thousand feet in China, has given rise to much discussion and controversy among geologists. The presence of the shells of snails that feed on plants indicates the former presence of plants. Accordingly it has been suggested that the genesis of these remarkable deposits may be fully accounted for by wind action, coupled with the growth of plants which have caught and compacted the blown dust and sand in the way that sand dune plants do at the present day on our seashores.

The Winds in the Free Air.—In the *Annals of Harvard College Observatory*, vol. 68, pt. 2, Mr. Andrew H. Palmer, research assistant at Blue Hill Observatory, publishes a discussion of "Wind Velocity and Direction in the Free Air," based on a great number of kite, *ballon-sonde*, and cloud observations, chiefly at Blue Hill. Comparisons of the wind conditions at various altitudes above the earth's surface are timely, in view of their great interest to the aeronaut. The general principles brought out are: (1) The general increase in velocity with height; (2) the rare occurrence of gusts of wind above low heights; (3) the frequent clockwise and the occasional counter-clockwise change of direction with height; (4) the shallow character of easterly winds (at Blue Hill); (5) the relative frequency of ascending currents as compared with those descending.

The Sizes of Rain Drops.—At a recent meeting of the Royal Meteorological Society Mr. Spencer Russell gave an account of the experiments that he has carried out at Epsom during the past two years to obtain a permanent record of the variations in the size of rain drops as they occurred. The first method employed was the exposure of a number of ruled slates, divided into quarter-inch sections, and gently brushed over with an even coating of oil. It was found, however, that in a heavy rain the drops striking the slate were broken up into a series composed of one large and several smaller ones. A more satisfactory method was that of letting the drops fall into dry plaster of Paris. Mr. Russell exhibited to the society a number of models of rain drops obtained in this manner. He stated that of the drops so far collected the diameters were as follows: 7 of 6 mm., 44 of 5 mm., 73 of 4 mm., 222 of 3 mm., 257 of 2 mm., 175 of 1 mm., and 107 of less than 1 mm.

Cadillac 1912

Cadillac progress

in scientific research marks a well defined line between the motor car of the past and the motor car of now.

Automatic electric starting device. Electric lights. Two complete ignition systems. Scientifically developed carburetor. More power. Larger wheels and tires. Larger brake drums. Steel bodies of latest accepted designs. Numerous refinements of essential details.

The improvements incorporated in this year's specifications will give a pronounced impetus to the conditions which have constituted the Cadillac *a law unto itself*.

These improvements are obviously the result of an economic and evolutionary development; hence, it is useless to seek them elsewhere.

They are the fruits of Cadillac research; of close and accurate measurement; and of *scientific standardization*.

Consider what an augmentation of comfort is implied in these two announcements emanating from the Cadillac Company, which has never promised what it did not fulfill—

First. A surpassingly fine car made infinitely finer; and Second, a hitherto unattainable ideal resolved into a practical reality.

This more refined and efficient car, is a product of that process of ceaseless progress toward perfection, which has prevailed in the Cadillac plant for ten years.

The simple, centralized, Delco system of starting, igniting and lighting is merely a phase, or *an integral part of that process*.

To combine these elements of efficiency, for the first time, in a unit, exercising the three separate functions, is of itself an interesting achievement; although such a system as an adjunct to an indifferent car, would be of doubtful value.

But to combine them in the Cadillac adds lustre to that achievement, because it *endows an extraordinary motor car with new and henceforth indispensable functions*.

Without them, the Cadillac would still be the incarnation of ease, grace, elegance and economy.

With them, a new meaning attaches to the word luxury as applied to motoring.

The 1912 Cadillac automatically removes itself from the realms of competition.

CADILLAC ELECTRICAL SYSTEM

Starting Lighting Ignition

The electrical plant in the new Cadillac not only accomplishes what heretofore has been accomplished in a less efficient manner by separate systems—ignition and lighting—but goes further and includes in its functions a feature to which motorists have long looked forward, an automatic starter which obviates the necessity of cranking by hand.

The plant consists of a compact and powerful dynamo operated by the engine of the car. The dynamo charges the storage battery.

For starting the engine, the dynamo is temporarily and automatically transformed into a motor, the current to operate it as a motor being furnished by the storage battery.

To start the engine, the operator, after taking his seat in the car, simply retards the spark lever and pushes forward on the clutch pedal. This automatically engages a gear of the electric motor with gear teeth in the fly wheel of the engine, causing the latter to "turn over," thereby producing the same effect as by the old method of cranking. As soon as the engine takes in charges of gas from the carburetor and commences to run on its own power, the operator releases the pressure on the clutch pedal, the electric motor gear disengages its connection with the fly-wheel and the car is ready to be driven. The electric motor then again becomes a dynamo or generator and its energy is devoted to ignition and to charging the storage battery.

The storage battery has a capacity of 80 ampere hours and as soon as that capacity is reached, the charging automatically ceases.

Practical tests have shown that the storage battery is of sufficient capacity to operate the starting device and "turn over" the engine about twenty minutes, although it seldom requires more than a second or two. In fact, the Cadillac engine so frequently starts on the spark that the use of the electrical starter is not always required.

The storage battery also supplies the current for lighting. The car is equipped with two especially designed Gray & Davis electric head-lights with adjustable focus, two front side lights, tail light and speedometer light.

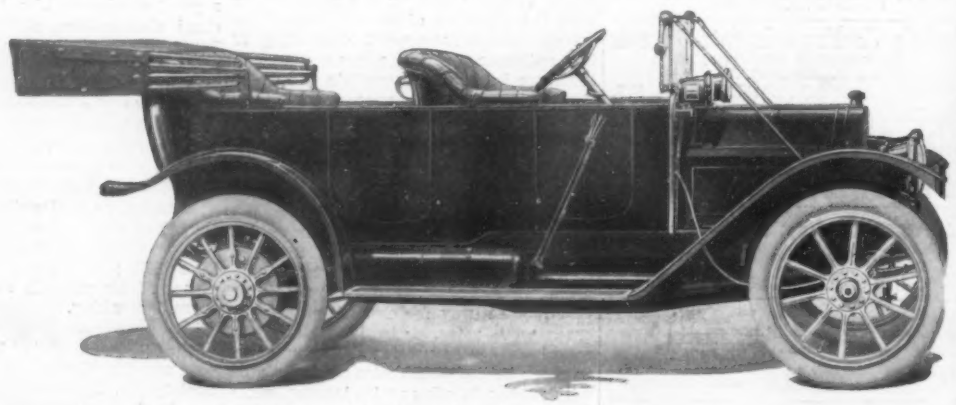
The dynamo also supplies current for ignition. Up to 280 to 300 R. P. M. the ignition current comes from the storage battery; above that speed the current is direct from the dynamo through the high tension distributor to the spark plugs. For ignition purposes the dynamo performs not only all the functions of the most highly developed magneto, but possesses even greater efficiency, having more flexibility and a greater range of action. When compelled to drive slowly in crowded thoroughfares, over very bad roads or on hills, with the usual magneto, the driver may stall his motor because the magneto is not being driven fast enough to generate current, and it becomes necessary to switch to the battery—if he has one. With the Cadillac system, if it becomes necessary to drive so slowly that sufficient current is not generated the battery automatically cuts in. When the speed is increased the dynamo again automatically takes hold. It wholly obviates the necessity of the driver's keeping constantly on the alert to prevent stalling the motor.

In addition to the ignition before described, the Cadillac is provided with the auxiliary Delco system with dry cell current which has proven so satisfactory in the past. The extra system is separate and distinct, with its own set of spark plugs and in itself is thoroughly efficient for running the car, entirely independent of the main system.

The entire electrical plant has been designed with a view to compactness and efficiency. It is designed with the idea of simplicity and positiveness. It is designed to obviate to the greatest possible degree the necessity of attention. Above all, it does what it is designed to do.

A few of the improvements in the 1912 Cadillac

Automatic electric starting device, electric lights. (See detailed description in another column.)
Increased power resulting from motor refinements and our own new carburetor. This new carburetor has not only simplified the matter of adjustments, but possesses maximum flexibility and maximum efficiency from low to high speeds without change of adjustment, excepting air adjustment controlled by small lever at the steering wheel.
Wheels and Tires. Increased from 34 in. x 4 in. to 36 in. x 4 in.
Brake drums. Increased from 14 in. to 17 in. diameter.
Bodies. Steel, of latest accepted designs; all fore doors, constructed upon new improved methods.
Gasoline capacity increased to 21 gallons on all models excepting Phaeton and Roadster, in which the increase is to 18 gallons. Gasoline gauge on dash.



SPECIFICATIONS IN BRIEF

MOTOR—Four-cylinder, four-cycle; cylinders cast singly, 4½-inch bore by 4½-inch piston stroke. Five-bearing crankshaft. Five-bearing cam shaft. **HORSE-POWER,** Nominal, A. L. A. M. rating, 32.4. Actual horse-power greatly in excess of that rating, due to Cadillac design, Cadillac principles and Cadillac construction. **COOLING**—Water, copper jacketed cylinders. Gear driven centrifugal pump; radiator tubular and plate type. **IGNITION**—See description under Electrical System. **LUBRICATION**—Automatic splash system, oil uniformly distributed. **CARBURETOR**—Special Cadillac design of maximum efficiency, water jacketed. Air adjustable from driver's seat. **CLUTCH**—Cone type, large, leather faced with special spring ring in fly wheel. **TRANSMISSION**—Sliding gear, selective type, three speeds forward and reverse. Chrome nickel steel gears, running on five annular ball bearings; bearings oil tight. **CONTROL**—Hand gear-change lever at driver's right, inside the car. Service brake, foot lever. Emergency brake, hand lever at driver's right, outside. Clutch, foot lever. Throttle accelerator, foot lever. Spark and throttle levers at steering wheel. Carbureter air adjustment, hand lever under steering wheel. **DRIVE**—Direct shaft to bevel gears of special cut teeth to afford maximum strength. Drive shaft runs on Timken bearing. **AXLES**—Rear, Timken full floating type; special alloy steel live axle shaft; Timken roller bearing. Front axle, drop forged I beam section with drop forged yokes, spring perches, tie rod ends and steering spindles. Front wheels fitted with Timken bearings.

BRAKES—One internal and one external brake direct on wheels, 17-inch by 2½-inch drums. Exceptionally easy in operation. Both equipped with equalizers. **STEERING GEAR**—Cadillac patented worm and worm gear, sector type, adjustable, with ball thrust, 1¾-inch steering post. 18-inch steering wheel with walnut rim; aluminum spider. **WHEEL BASE**—116 inches. **TIRES**—36-inch by 4-inch Hartford or Morgan & Wright. **SPRINGS**—Front, semi-elliptical. Rear, three-quarter platform. **FINISH**—Cadillac blue throughout, including wheels; light striping, nickel trimmings. **STANDARD EQUIPMENT**—Dynamo with 80 A. H. battery for automatic starter, electric lights, and ignition. Also Delco distributor system. Lamps especially designed for Cadillac cars, black enamel with nickel trimmings; two headlights; two side lights, tail light. Hans gasoline gauge on dash; horn; full foot rail in tonneau; half foot rail in front; robe rail; tire irons; set of tools, including pump and tire repair kit; cocoa mat in all tonneaux except closed cars. Speedometer, Standard, improved with 4-inch face and electric light.

STYLES AND PRICES:—

Touring car	$1800.00
Phaeton	1800.00
Roadster	1800.00
Torpedo	1900.00
Coupe, Sedan type, aluminum body	2250.00
Limousine, Berline type, aluminum body	3250.00

Prices F. O. B. Detroit, including standard equipment.

CADILLAC MOTOR CAR CO., :: :: :: Detroit, Michigan